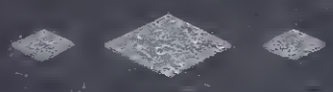
THE

UNION PACIFIC COAL COMPANY



Reprinted from The Mining Congress Journal, February, 1930.

The Union Pacific Coal Company

A series of articles describing this company's coal mining operations and organization in the State of Wyoming

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The Union Pacific

EUGENE MCAULIFFE

President,
The Union Pacific Coal Company

Coal Company

By Eugene McAuliffe*

Modernizing program begun in 1923—Better labor relations established—Paternalism avoided—Mechanization has resulted in increased yearly earnings—Wage scale designed to equalize different classes of labor

THE series of articles which follow, broad in compass, cover very capably the activities of The Union Pacific Coal Company, a property located in the State of Wyoming, whose annual production of bituminous coal approximates 3,000,000 tons. The 20 odd staff officials contributing, enjoy a familiarity with the property and its employes that especially fits them to report every detail that relates to the operation of the properties.

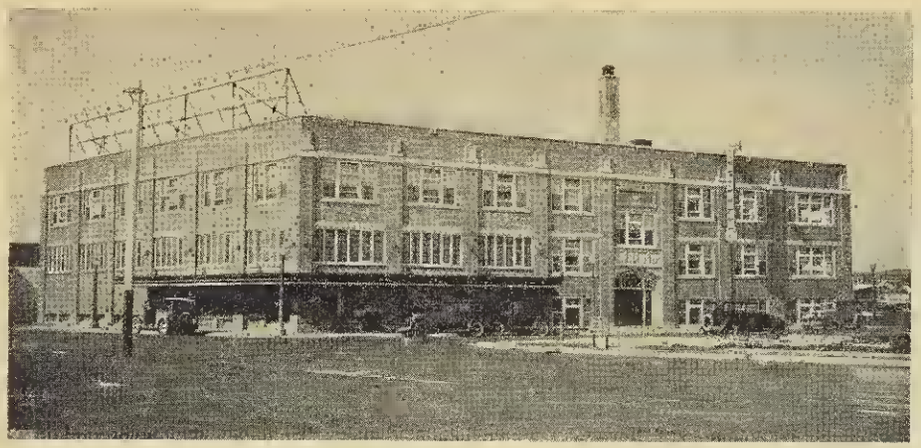
Like the speaker last positioned on an extended program, the writer finds it difficult to find a single remaining phase of operation or management to touch upon; it may, however, be of interest to the readers of THE MINING CONGRESS JOURNAL to know something of the underlying policies that actuated the management of the property, during a period in which, what is perhaps the largest mechanical loading program in a coal mining property, whether located in the United States or elsewhere, was gotten under way. The tonnage loaded mechanically in 1929, will exceed 1,750,000 tons.

The writer came to the property on March 1, 1923, finding 17 mines then in operation, the maximum daily output 16,500 tons, or an average of 970 tons per mine. The property, as American coal properties go, was a rather old one, having produced its first coal in 1868. The 17 mines were all developed by slopes driven in from the crop line, the tipples of wood construction, the mine equipment throughout, except as to an extension of the use of electric power, not much changed during the preceding generation. Unfortunately, the previous managements, perhaps because of limitations placed upon them, continuously perpetuated small mines, narrow track gages (much 30 and 36-in. used), together with correspondingly small pit cars (3,000 to 4,000 pounds capacity). The only material alteration made in the underground mining methods were those of changing from rooms driven from strike entries to the rise, to a panel system with rooms driven on the strike. This change was merely begun in 1923, and while representing a definite improvement in hand loading methods, only added new complications when the work of introducing mechanical loading was begun. This double method of operating within individual mines offered in certain instances a rather spotted situation into which the loading machines were necessarily introduced. While definite progress has been made toward clearing the pillars out of the former hand loading territory, an examination of certain recent mine maps evidences the fact that the process of "mopping up" old territory, will continue to drag along for some years.

GEORGE B. PRYDE
Vice President,
The Union Pacific Coal Company

Any survey of a coal mining situation preparatory to introducing mechanical loading should begin with the labor employed in and about the mines. The theory of "self-determination," while given world publicity following the Great War, is in no sense a new thing to the coal miner. Professor Carter Goodrich, in his interesting and informative book dealing with coal miners and coal mining, has referred extensively to this age old characteristic, using the term "the miners' freedom." This writer said in substance, that the miner, a strong, virile, "danger be damned," individual, doing the best he could under what might be called fortuitious circumstances, was loath to accept new methods of getting out coal, more so when such contemplated the elimination of the tonnage basis of payment. The miner's "place" is, in a sense, his castle. His attitude toward interference is not unlike that expressed by a great English statesman and pleader of the early eighteenth century, who said; "the poorest man may in his cottage bid defiance to all the force of the Crown—the storms may enter, the rain may enter, but the King of England cannot enter." Such in a way expresses the attitude of the experienced coal

* President, Union Pacific Coal Company.



The Union Pacific Coal Company's Headquarters Building, Rock Springs, Wyo.

miner when the employer seeks to invade his room or place.

The coal mine worker, as a class, represents the last stronghold of labor individualism. His life has in the past and in too many instances does yet, run a troubled course. The work is definitely hazardous, but perhaps the most sodden side of existence confronting him and his family is that of the uncertain tenure of mine employment. With this feeling ingrained in his mind and blood, it is not strange that the introduction of machines, presumably bought to take his place, would invoke other than a welcoming attitude.

The overwhelming majority of mine workers employed in the Wyoming mines are men of sterling qualities. Perhaps in no set of mines can be found a wider diversity of racial origin. The Union Pacific Coal Company forces embrace 49 nationalities. Racial animosities are, however, strange to say, non-existent. The unification displayed through their general activities, whether organized or social, is quite remarkable. Our schools, churches and Sabbath Schools are wonderfully supported and attended, and the desire for higher educational advantages for the workers' children, finds continuous expression in all our communities. With this situation in mind, the opportunity to lay a foundation of good will, predicated on the theory that a good workman had certain rights, seemed propitious.

The scale of wages paid in Wyoming were, and are yet, relatively high. All mine labor within the state was, in 1923, as now, organized. Unfortunately, the continuously recurring strikes occurring in the central competitive field had unsettled both operator and mine worker, and as labor could be obtained without serious consideration for the element of continued employment, men were piled into the properties in such number that made it possible, anticipating a strike alarm, to get out a heavy tonnage. The end result of this situation was evidenced in a high percentage of boarding house habitues, a slow turn, much absenteeism, coupled with dissipation, and resultant low earnings for all.

The solution of this problem seemed plain. With a labor turn-over approximating 125 percent annually, reduction of force came quickly when the employment of men ceased. An attempt was next made toward the establishment of a measure of mutual confidence which would tend to eliminate shut-downs, making it possible to increase the monthly and annual earnings of the men. Early in the mechanical loading program, the policy of refusing to release men to put machines in their places, was put into effect, and made public. Machines were introduced only at such times and in such numbers as the natural reduction in forces made possible. So it may be said that The Union Pacific Coal Company's mechanical loading program had its inception in an attempt at human engineering.

During the early mechanical loading expansion period, black powder and the carbide lamp were supplanted by permissibles and Edison electric cap lamps, a program of bath house, school house, and community building construction was carried on, and the various social activities referred to in detail in certain of the staff papers were gotten under way. It would perhaps be appropriate at this juncture to say that the officials of the company neither attempt to lead in, nor control, the social and religious life of our employes; on the other hand, we are definitely committed to the theory that paying workmen in part money and part social privileges is as un-American as it is unsound. Workmen should buy their own amusements and their earnings should contemplate just this situation. Paternalism in any form is objectionable to the great majority of men.

Reference has been made to the fact that the Wyoming mine workers are well organized. The history of organized mine labor in the past 10 or 12 years has not been such as to make friends for the Union. Stripped as it now is of the tremendous power it exerted over the economic life of the nation as late as 1922, and torn by internal dissension, it would not require extraordinary effort to eliminate the Union in the remaining organized portion of the Rocky Mountain Region. Whatever the crimes committed in the past by the Unions, such have in our opinion been fully paralleled in the abuses put upon mine labor by many employers, and with an abiding confidence in the ultimate good intention of workmen as a class, the management of The Union Pacific Coal Company decided to give the Union the widest possible chance to establish itself upon the property, on a business-like basis, asking only that the extreme element that had drifted into the coal mines from the old radical metal mining atmosphere, be shaken out, all theories of "wobbly" propensites to be eliminated. To the end that the Company's theory of relationship might be given the fullest trial, a former President of the United Mine Workers organization, Mr. John P. White, was chosen early in 1929 as Umpire, to arrange the settlement of any differences that might arise between the company and its men. For a coal company occupying a definite fuel supply relation to a great trunk line railway, to place its labor affairs in the hands of a man whose life has been spent in the service of the Union might seem injudicious, but we were willing to take the chance. The arrangement was later extended to cover 90 percent of the state production of coal, the coal operators of Illinois thereafter following the precedent established in Wyoming, the Hon. W. B. Wilson, former Cabinet officer and past Secretary of the Miners' Union, now engaged in adjudicating the differences that arise between employers and mine workers in Illinois.

Commencing with the year 1926, an exact record of working time and earnings of all Union Pacific workmen has been maintained, and while the average daily earning of the men has been reduced by the substitution of day labor for tonnage rates, the reduction in man power obtained by failing to replace separations from the service, has made it possible to increase the monthly earnings of the men. This increase continued steadily up to the date of the wage revision made December 1, 1928, and what is more remarkable, the average earnings of the men employed during 1929 under the reduced wage, has been brought up to a point approximating the earnings made under the previous scale, this in the face of the fact that from 10 to 14 days vacation was extended to the men employed in all but one mine.

The earnings of all men and boys,

exclusive of the official staff, together with working time for the period referred to, were as follows:

Year	Average Days Worked	Average net earnings, all men and boys Per Day	Per Month	Per Year
1926....	208.3	$9.43	$163.76	$1,965.87
1927....	238.5	9.02	171.82	2,064.03
1928....	259.8	8.60	186.23	2,234.76

The wage scale was modified on December 1, 1928, otherwise the rates paid were uniform throughout the three-year period. The figures for the year 1929 are not as yet available.

Comparisons, whether in or outside of the mining industry, are "always odious." Under the hand loading scale, certain classes of men paid on a tonnage basis were enabled to earn abnormally high rates of pay. This situation found expression in the form of pay checks that ran 200 percent and upward of the amount earned by the men paid on the day wage basis. In addition to the increased measure of affluence enjoyed by the tonnage men, they could, while keeping their income at a high point, afford a greater measure of absenteeism than could the day worker. With the same general cost of living, the same desires for amusement, the education of their children, etc., this disparity in earnings between men living in adjoining houses bred discontent. The equalizing effect of a 60 percent translation from hand to machine loading brought about a substantial leveling effect between our men employed in the various tasks. The measure of time worked by the seven general classes of mine labor with their average monthly earnings for the year 1928, shown below:

Occupation	Average Days Worked	Average Net Monthly Wage
Machine runners and helpers	264.1	$200.52
Miners and loaders	212.5	186.90
Haulage men	276.3	178.00
Timbermen and trackmen	283.9	184.57
General inside	277.8	183.62
Surface men	312.9	189.06
General outside men	309.5	189.61
Average all men	259.8	$186.23

It will be noted that the spread in working time runs from 20 percent above to 18 percent below the average of all men, while the spread in monthly earnings ranges from 7.6 percent above to 4.4 percent below the average of all men. With the transition stage passed, we anticipate an even better equalization of earnings and working time.

There are certain classes of mine labor that deserve a wage above that paid to men in less hazardous, less arduous and less responsible positions, but the old basis which yet obtains in many hand loading mines tends to create an artificial aristocracy for a portion of the workers, while the others are given a wage that, while comparing favorably with rates paid in the skilled trades, is definitely below that paid to the tonnage men who are their immediate neighbors and associates. No branch of society will keep happy and wholesome where a caste system exists.

In the making of the last wage agreement, provision was made for the formulation of rates of pay to men employed in the operation of loading machines, either on a "tonnage or a combination of tonnage and day wage basis," such special agreements to be arrived at between the individual operator and his men, and to apply only to the mines and classes of machinery covered by the new agreement. It is the belief of our management that with adequate data of past performance available as a basis, a combination rate can be developed that will not only increase the earnings of men employed in mechanical loading, including the operation of cutting machines and electric drills, but which will also increase the average daily output for each machine employed.

The progress made toward stability of employment and a reasonable annual earning with a substantial decrease in mine cost has been brought about, not only by the introduction of coal loading machinery, but likewise by the following:

(a) Discontinuing the practice of storing railway fuel during the fall and winter peak demand period previously made necessary by actual or threatened suspensions, this situation possible with a composed labor supply.

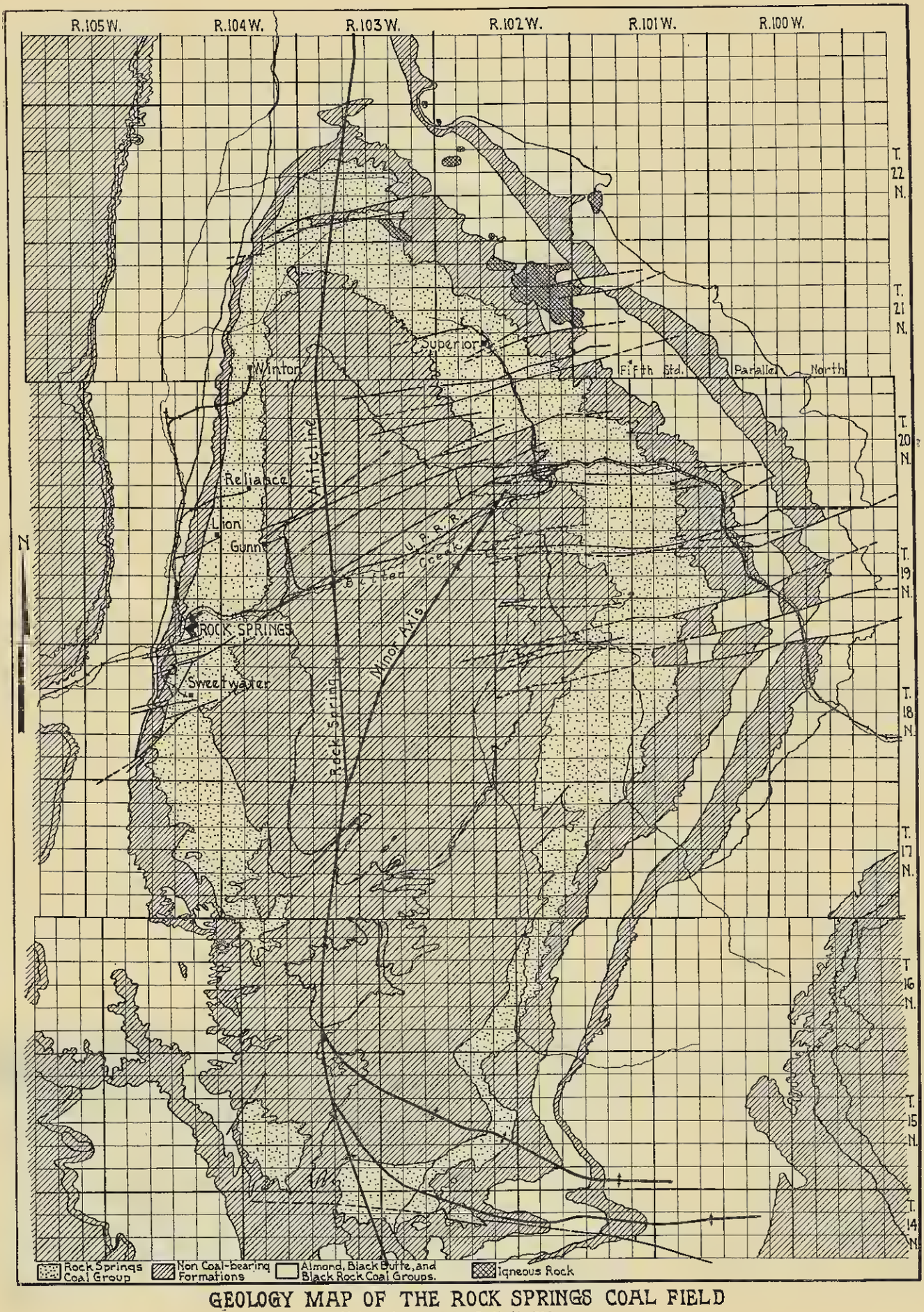
(b) The production of a certain tonnage of coal for storage purposes during the period of low railway fuel demand, April to July, inclusive; this coal transported to destination by the railroad when coal cars are plentiful, is taken up and used during the peak demand period when transportation demands are heaviest.

(c) The concentration of all construction work in and about the mines during the dull season, with loading machines in part, taken off room and long face work, and used to push development work as far as possible during the dull season.

Some 30 years ago, a railway superintendent named Brown, served a small eastern line, The Fall Brook Railway. In that day, railroads and railroad employes were rather a mixed lot. The theory of "hire and fire" was uppermost in the minds of the men in charge of operation, as well as with the trainmen, enginemen and shop men. Laborers got a dollar for 10 hours and were without social status. Superintendent Brown had humanitarian instincts, coupled with sufficient vision to discern that the continuous shifting of men was not only costly, but that it likewise stood in the way of better service. Mr. Brown evolved what was known as the "Brown System of Discipline," a system of merit and demerit marks used in lieu of suspension and discharge. The plan spread, until today it is substantially universal on the railroads of the United States and Canada. Superintendent Brown is dead, many younger railway employes never heard of him, but the theory of using "Brownies," "goes marching on." Perhaps only a few railway executives ever think of the "Brown system" as marking the beginning of the changed dispensation which has placed the railways at the top of all American industry; such, however, is the case.

The railway industry and the coal industry are insolubly related. Not because the properties in our charge belong to a great railroad company, but rather because of the example set by the railroads as a whole, we have attempted to think of coal mining and coal mining labor problems as quite as amenable to the application of business vision, rigid integrity and a just recognition of the fears as well as the hopes and aspirations of every employe, such as was found to be the case by the railroads. Men have come to visit our properties from every coal mining field in Europe, Asia, Australia, Canada, Mexico, and the United States. They have said many kind things about us, most of them undeserved. We ourselves well know that the road toward betterment is long and rough; we are, however, trying to put a milestone or two behind us each year.

Longwall face at No. 8 Mine, Rock Springs, Wyo.



GEOLOGY MAP OF THE ROCK SPRINGS COAL FIELD

Taken from U.S.G.S. Bulletin 702

FIGURE NO. 1

The GEOLOGY of the Rock Springs Coal Field

Topographic features—Geology of field with charts showing cross section of coal formations—Description of seams

By C. E. SWANN *

THE ROCK SPRINGS uplift is located in the south central part of Sweetwater County, Wyoming, and the developed portion of the Rock Springs Coal Field occurs in the northern end of the uplift. This part of the field was made the subject of a geological study and a part of the area subdivided during the summer of 1907 by Geologist A. R. Schultz and party. Topographic locations as well as line measurements were made by stadia: coal outcroppings and prospect pits were located carefully, and reliable geologic and topographic maps have been published by the Government which are of great assistance to anyone interested in the coal or oil and gas developments of this region. The map and cross section of the Rock Springs uplift used with this article are reproduced from U. S. G. S. Bulletin No. 702.

Topographic Features

The field here considered is the northern rim of the Baxter Basin Oil and Gas Dome which is completely surrounded by Tertiary beds. Within the field the principal topographic features are due to (1) hard resistant sandstone of the Mesaverde; (2) hard resistant limestone and sandstone of the nearly horizontal Green River and Wasatch formations; (3) migrating sands; (4) soft beds of the Wasatch, and (5) igneous rock.

The hard, resistant sandstone of the Mesaverde forms a concentric ring of hills, more or less continuous about the central portion of the Rock Springs or Baxter Basin dome. These concentric ridges contain the most important coal beds of the field and are usually separated from each other and from areas of equal or more elevated younger rocks by belts of low relief. The two most pronounced depressions are carved in the soft shale overlying and underlying the Mesaverde sandstone. The low valleys are natural routes of travel and afford easy access from the railroad to the more rugged ridges containing the coal. The shale below the Mesaverde gives rise to low relief along the central part of the Rock Springs dome.

The hard, resistant limestones of the Green River and Wasatch formations produce a topography noted for its table-like forms, bounded by prominent escarpments occurring in regular benchlike succession, giving a characteristic bad land impression.

Huge sand dunes formed by the migrating sands are the most conspicuous topographical feature in the northern part of the field. The soft beds of the Wasatch form a low depression along the synclinal trough of the Great Divide Basin. This formation contains numerous beds of coal, few of which are well exposed. The topographic features are such that the coals are readily accessible.

In this field igneous rocks rise like land-marks above the high mesa surrounding the Superior mining district on the north. The lava formin
flowed from a little group of volcanoes far removed from similar centers of igneous activity. These concentric cones, needle-like necks, irregular dikes, and table-like sheets afford a striking contrast to the topographic features of the surrounding hills, and during recent years serve as guide monuments to airplane travel across this barren region.

Bitter Creek, the only prominent stream in this field, flows across the central part of the field at nearly right angles to the central axis of the Rock Springs Dome, carrying this district's drainage toward the Pacific Coast. The stream has carved out a broad valley, along which the Union Pacific Railroad was constructed. The Union Pacific Railroad gives a direct outlet east and west for the mineral deposits of the Rock Springs dome.

Stratigraphy

(*From U. S. G. S. Bulletin No.* 341.)

The fossils collected by A. R. Schultz and party, during the 1907 work in this field and studied by F. H. Knowlton and T. W. Stanton, indicate the formations have the following geologic time value:

Tertiary Formation

Three hundred and fifty feet Green River sandstones, unconformity, 600 ft. of shales and limestones of Green River formation (most important spring horizon), contains some coal; unconformity, 400 to 825 ft. variegated clays, shales and sandstones. Twelve hundred to 2,650 ft. Wasatch formation containing the Black

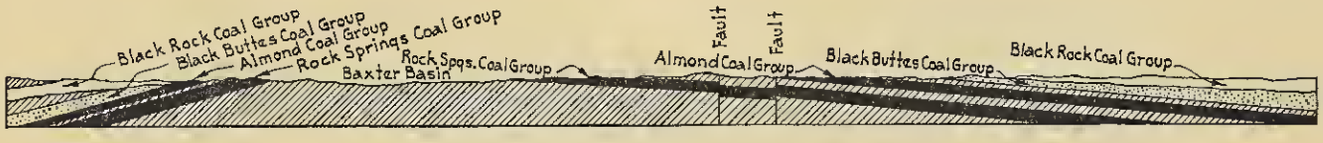
Rock Coal group. Prolifically coal bearing with many thin beds of coal and at least one bed 25 ft. in thickness. Yields artesian water. Flowing well at Bitter Creek. Unconformity.

Cretaceous Formation

Two thousand three hundred and seventy-one feet of Laramie formation (?) containing the Black Buttes coal group of numerous important coal beds, none of which are being developed at the present time, 750 ft. of Lewis shale, non-coal bearing Mesaverde divided into Almond coal group, 900 ft., in which coal has been mined at Rock Springs and Point of Rocks, 800 ft. of massive white and yellowish sandstones yielding artesian water in parts of the field; the Rock Springs coal group, 2,400 ft. thick, containing the best coal in the Rock Springs field. Important mines are operating the Rock Springs coal group at Rock Springs, Quealy, Lionkol, Reliance, Dines, Winton and Superior. Artesian water zone, bottom member 2,350 ft. drab, yellow and brown sandstones, and interbedded shales in which massive sandstones are grouped near the top giving rise to the "Golden Wall" surrounding Baxter Basin oil and gas field.

The oldest coal bearing rocks exposed in this area are of Montana Age. In gas wells drilled in the northern end of

* Chief Engineer, The Union Pacific Coal Company.



Cross Section of Rock Springs Coal Field along line one mile north of Fifth Standard Parallel North
Taken from U.S.G.S. Bulletin 341

FIGURE NO. 2

Baxter Basin thick seams of coal have been cut in the Frontier formation of the Colorado group at depths ranging betweeen 3,500 and 4,000 ft. These seams are probably of similar character to the coal found in Uinta County in the vicinity of Kemmerer and Cumberland.

Rock Springs Coal Group

The Rock Springs coal group is the most important and the one containing the highest grade of coal in this area. Its basal portion consists of heavy, ridge making coal, bearing sandstones and the remainder of brown, yellow and white sandstones, shale, clay and interbedded coal. The group is prolifically coal bearing throughout, containing over one hundred seams, varying in thickness from 1 to 18 ft., of which at least twelve beds are over 5 ft. in thickness in some part of the field. These beds occur somewhat regularly throughout the group and are fairly persistent along the strike. They have been prospected along the outcrops from the town of Quealy (old Sweetwater) through Rock Springs along the rim to the town of Superior. Only a small amount of prospecting has been done south of Superior on the east rim due to the thinning out of the seams which make them unattractive for mining purposes at the present time. This coal is, however, of high grade and will undoubtedly be mined at a future date.

The Union Pacific Coal Company operates mines at Rock Springs, Reliance, Winton and Superior, producing coal for railroad use only, while commercial mines are being operated at Quealy, Rock Springs, Lionkol, Dines and Superior. The first mines of any size were opened in this field during 1868 and the present annual production of the district is approximately 3,500,000 tons.

The coal beds dip away from the rim from almost level to 20 degrees. The workable coal extends back from the surface outcrops from one to three miles or until the cover becomes too heavy to permit of economical mining. There are six seams of workable thickness at the town of Rock Springs, known locally, in order of their occurrence as Seams 5, 3, 1, 7, 11 and Van Dyke. The question naturally arises, "How did the workable seams acquire their names?" Original mines Nos. 1 and 2 were opened on the third workable seam below the top of the series and this seam became known as No. 1 Seam. No. 3 Mine was next opened on a seam above No. 1 and the seam became known as No. 3 Seam. No. 5 Mine was opened on a seam above No. 3 and this seam became No. 5 Seam; No. 6 Mine was opened in one of the lower seams of the Almond series and this seam is known as No. 6 Seam; No. 4 Mine was next opened on No. 1 Seam and the next mine opened was No. 7 on a seam below No. 1 Seam and this seam became No. 7 Seam. The Union Pacific Coal Company Mines 8, 9 and 10 have since been opened on No. 7 Seam. About 1868 the Van Dyke mine was opened up on a seam some distance below No. 7 Seam and this seam is known as Van Dyke seam.

An attempt to number consecutively the workable seams below No. 7 Seam has been made but this is difficult of accomplishment because seams workable in one locality become thin or dirty and unworkable in other localities while seams too thin to be workable in one locality thicken and become workable in other sections of the field. The workable coal occurs in lenses and a nice engineering problem is presented in determining the proper location for point of development of a new property due to topographic features and the heavy expense involved in properly diamond drilling the proposed workable area. During the past forty years a large amount of surface prospecting has been done along the different outcrops and numerous drill holes have been drilled to the different seams to determine where the seams are workable, but additional drilling sometimes completely changes our ideas concerning a specific coal property.

An ideal geological section showing the relative position of the workable seams in the Rock Springs series taken just north of Rock Springs (sketch III) is presented to give a graphic illustration of the coal measures. Coal seams under 5 ft. in thickness are not considered economically workable in this locality at the present time, due to distance from market, and to the fact that a number of seams much (*Continued on next page*)

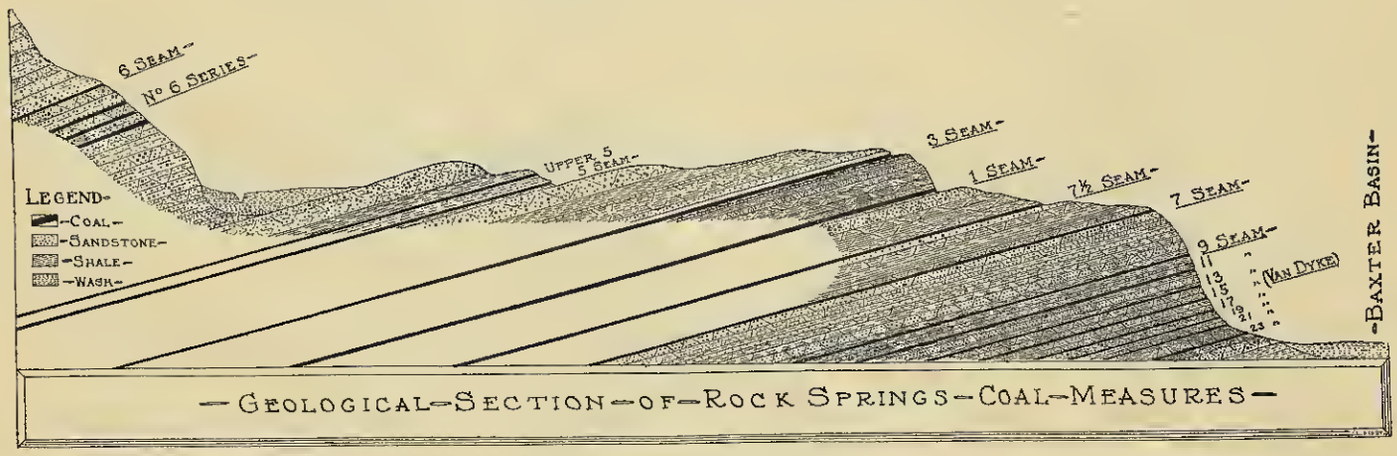


FIGURE NO. 3

Footprints of PREHISTORIC DINOSAURS

By C. E. SWANN *

Footprints made a million years ago are plainly marked in roof strata at Superior and Reliance Mines—Interesting evidence of prehistoric animal life

DURING Triassic times, when mammal-like reptiles had begun to wane, there arose a race, the Dinosauria, which in their way, were just as perfectly adapted for easy and even rapid progress on the land. These became both the dominant reptiles and the dominant land animals of the late Triassic, the Jurassic and the Cretaceous periods, a stretch of time which may with equal truth be called the "Age of Reptiles" or the "Age of Dinosaurs." The dinosaurs had a common ancestry with the crocodiles. The distinctive feature of the order was a bipedal gait. This determined many of the other structural peculiarities. With the whole weight of the body thrown upon the hind limbs the attachment of the girdle to the backbone had to become greatly strengthened. There is little doubt that dinosaur footprints embedded in the overburden of the coal seams at Superior and Reliance indicate the animals walked on their hind limbs.

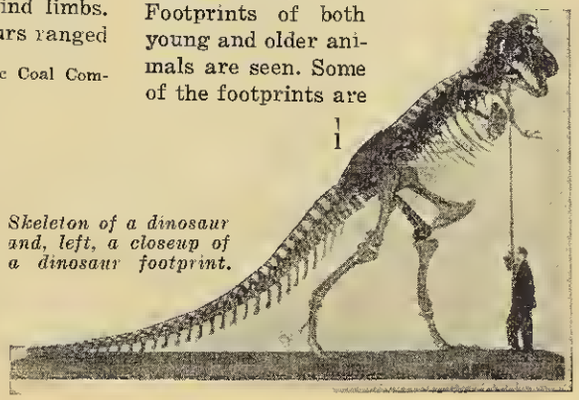
The primitive horned dinosaurs ranged at least from New Mexico northward to Canada. They were peaceable plant-eaters and obviously needed protection from their enemies, the carnivorous dinosaurs. Hence the head was armed with horns, the neck was protected by the bony frill or shield, and the body was covered with a tough, scaly hide. These were the ancestors of the Triceratops, which roamed the western plains at a later time.

In the late Cretaceous or early Tertiary Age a group of reptiles (Triceratops), which were contemporaries of the huge carnivorous dinosaur, roamed the western plains and we are reasonably certain the huge carnivorous dinosaurs inhabited the Superior and Reliance districts of Wyoming because their tracks are plainly visible in places in the roof strata of the Superior and Reliance mines. These tracks are very similar to those of a huge bird. Footprints of both young and older animals are seen. Some of the footprints are about 12 in. in diameter while others are from 24 to 30 in. in diameter and 36 in. long (see illustration), these prints extending downward from the sand shale roof and into the coal as it was in place (see illustration). The stride of these animals was about 10 feet long, indicating a monstrous creature, and we are told some attained a length of 50 feet, a height of 18 ft., bad jaws 5 ft. long, armed with long, sharp teeth adapted to tearing flesh.

In the late Cretaceous period dinosaurs roamed everywhere, big lumbering creatures as big as many elephants, wading in the streams and lakes, feeding on water plants, smaller dinosaurs stalking by the water side or splashing into tbe water and swimming hastily away upon the approach of some flesh-eating dinosaur looking for his dinner or supper and little dinosaurs scurrying out of the way.

Until 1877, although many fossil remains of prehistoric dinosaurs had been examined by eminent geologists and others, no attempt at restoration of a complete skeleton had been made, and Professor O. C. Marsh is credited in some sources as being the first to partially assemble the fossil remains of the dinosaurs.

In general, it may be said that the Tertiary period was ushered in by a world-wide revolution. Seas changed places and mountains arose where sea water had been. Whole races of animals were obliterated and new races took their places. Whole floras, or groups of plants, disappeared and new floras appeared. It was during this period that the dinosaur disappeared.



Skeleton of a dinosaur and, left, a closeup of a dinosaur footprint.

GEOLOGY OF ROCK SPRINGS COAL

(Continued from preceding page)

thicker are available for development. Rock Springs coal acquired its reputation on the commercial market from coal mined from No. 1 Mine, but coal mined from several of these seams gives satisfaction on the commercial market.

No serious attempt has been made to accurately determine the total amount of workable coal in this field as it would entail an enormous amount of diamond drilling and outcrop prospecting to obtain sufficient data to properly calculate same, but enough information is available to demonstrate the fact that only a small percentage of the coal resources has been extracted, and that enough coal reserves exist for the continued operation of mines over an indefinite period.

* Chief Engineer, The Union Pacific Coal Company.

HISTORY of Union Pacific Company's MECHANIZATION

Early hand methods—Introduction of cutting machines and electric haulage—Mechanical loading as employed in thick coal—Loading machines, conveyors, scrapers, and pit car loaders now used—Development of McCarty Duckbill—Summary of tonnage and equipment investment 1923 to 1929

By A. W. DICKINSON *

IN THE YEAR 1868, the transcontinental railroad construction program, deemed so important by the United States Government and by the people of the Pacific Coast and of the more thickly populated territory east of the Missouri River, was brought to successful culmination in the joining of the tracks at Promontory, Utah. The Union Pacific Railroad, building west from Council Bluffs, Iowa, and the Central Pacific Railroad, building east from Oakland, Calif., had pushed their lines over hundreds of miles of non-revenue desert territory in order that the only recently acquired territory of the Pacific might be bound to the United States of America for all years to come.

Early in the projection of the plan for a transcontinental railroad, the necessity of an adequate fuel supply was recognized and the reports of coal occurrence in Wyoming, included in General Fremont's reports of earlier date, received the consideration due to their importance. The potential fuel supplies indicated by the coal outcrops were important factors in the determination in location of the route of the railroad. At the points later identified as Rock Springs, Carbon and Almy, coal mines were developed, the work necessarily being a hand operative job.

With the limited knowledge available, in the mountain area at that time, the early mining was extremely simple. At a later period steam driven hoists, fans and pumps were introduced, particularly as the slopes progressed to the dips following the pitch lay of the coal. The work of the earlier days was performed largely by English speaking miners, but, as the comforts of the mining locations were meager, the increasing demand for coal resulted in a shortage of labor. This shortage was met by the introduction, into the mines, of Chinese brought on

after the completion of construction work on the Central Pacific Railroad. For many years the Chinese carried on under the direction of the English and American mining men and only in the last few years have these picturesque workers faded from the scene.

The first successful step in replacing the hand mining came through the introduction of compressed air undercutting machines of the reciprocating type. With the increasing length of haul came the electric locomotives and accompanying the use of electric power came also the realization of the superiority of electric power from the transmission viewpoint as compared with compressed air. Electrically driven undercutting machines followed this realization, paralleling the practice of other coal fields in eastern states, in that the breast machine was the pioneer, followed by the short-wall machines. Electric driven motor drills, for the placement of shot holes in the coal, arrived with the electric coal undercutting machines.

While the laborious task of undermining the coal through the agency of picks, wielded by hand, had been in a large measure solved, the heaviest work of all remained an untouched problem. Coal was still being loaded through the agency of the hand shovel. Thousands of men shortening their lives, particularly in the high mountain altitudes, in an endeavor to gain a livelihood. The mechanical loading of coal, in the underground workings, first received attention at the Hanna property in southern Wyoming. In the Hanna mines the thick bed of coal, 32 ft. from foot to hanging wall, on a 17-degree pitch, prompted the thought of employing boom and dipper stick types of shovels powered by electric motors. These shovels required 28 ft. of width and 18 ft. of height to permit of operation, but such was the nature of the coal deposit that the shovels were given freedom of room for operation and hence in 1914 this loading practice was inaugurated. Continuing on to the fall of 1923, Hanna increasingly felt the difficulty of projecting development work with a rapidity sufficient to keep working places for the shovels and in December, 1923, two Joy 4-BU loading machines were placed in operation, for the duty of driving the "first mining work" for the large shovels. The habit of single shift work in the 24-hour period of each day was still prevalent over the coal fields of the United States and had its influence in the development problem at Hanna. In April of 1924, two more Joy 4-BU loading machines were placed in operation and the results closely watched for the balance of the year.

As the performance of the mechanical loading equipment became apparent, the discussion of the trend toward mechanical loading, in southern Wyoming, grew

* General Superintendent, The Union Pacific Coal Company.

in importance and resulted, in the early part of January, 1925, in the decision to investigate further. In carrying out the investigation an operating engineer was sent east and in January and February of 1925, spent thirty days in observation. The problem at that time was:

(1) To seek a loading device or machine which would best carry on and meet the need at Hanna.

(2) To seek devices applicable to tbe lower coal and varying band rock and roof conditions of the Rock Springs Field, where pitches vary from 4 to 17 degrees.

The study of the various loading devices was carried on in Missouri, Illinois, Indiana, Ohio, Pennsylvania, West Virginia, Virginia and Kentucky. In passing, it is of interest to note that during this period of observation information was received concerning certain shaking conveyors in use in the anthracite region of Pennsylvania. These conveyors had been manufactured in the United States as the result of studies made by American Engineers while in Germany and Great Britain. This information was considered and discussed by the staff of The Union Pacific Coal Company in Wyoming, but it was not realized, at that time, early in 1925, that such conveyors had a place in the Wyoming plans. The report of the observations, made on mechanical loading devices, in the eastern states, was carefully studied and discussed by the Wyoming Staff and resulted in the decision:

(1) To place more Joy 4-BU loading machines at Hanna, Wyo.

(2) To build a large scraper for trial at Rock Springs.

In April, 1925, the trial scraper was placed in service underground in a laboratory area dedicated to research. This device continued to load coal for over a year, developing information on the problems of roof span, timbering, sheaves, sheave anchorage, rope, cutting of coal, shooting of coal and much tributary detail. Soon after the installation of the trial scraper a complete unit was ordered from the Goodman Manufacturing Company of Chicago, installation being made as of February 1, 1926. The operation of this 125-h. p. unit resulted in the placement of seven additional scrapers in April of 1926.

Turning from the scrapers, for the moment, and returning to July, 1925, in order to allocate the chain of events, we find that at that time discussion was revived on the shaking conveyor. An American Engineer was considering the agency for a German-made conveyor and planning an inspection of these devices in German mines. In the event his observation of the conveyors in Germany resulted in approving the device, the

Seven hundred and more years of brain stunting toil

opportunity was offered American clients to purchase shaking conveyor units through the American Agency. In the literature, setting forth the appearance and manner of use of the German shaking conveyors, appeared an extensible pan to be used at the face end of the conveyor. The device was shown as in use in a potash mine in Germany. The sides of the lower and upper pan were drilled at approximately 6-in. centers and through the use of bolts the pans were held together. If it was desired to extend the upper pan, the bolts were removed, the pan shoved out until holes were brought to a match position and the bolts replaced. From the consideration of these extensible pans it was but a brief thought to the conception of a similar pan which might be made to feed forward or be retracted rapidly.

In October, 1925, the first Eickhoff Shaking Conveyor unit arrived and was placed underground at Superior, Wyo. The first service was in driving narrow work up the pitch, shooting the cuts of coal on to the extensible pan and making rapid progress thereby.

The proposed rapidly feeding duckbill was discussed at length and the trials of many devices to accomplish this end followed. Among the attempts may be mentioned the feed sprocket and chain taken from a well known type of undercutting machine. This sprocket was operated first through the agency of a hand crank, next by means of a ratchet, similar to the common drilling ratchet, and again by a 1½-h.p. electric motor. In another of the mining fields, the extension of the pan was attempted through the agency of a feed screw similar to that used on a lathe. This was followed by the development of the sprocket wheel and rack bar device, known as the "McCarty Duckbill." The last named device embodied the virtue of using the reciprocating movement of the conveyor for the advancement and retraction of the upper pan, and it is this feature wbich has made the later duckbills successful.

At the time of the development of the McCarty duckbill, another useful device for conveyor operation was developed and brought into heing. This was the swivel, by means of which the duckbill could be operated radially, so that through its use a wide room face might be loaded out.

In the meantime, the matter of providing development for the scraper loaders had become a pressing problem and tbe realization of the value of the shaking conveyor and duckbill resulted in the placement of orders for additional shaking conveyors. Continued use of this equipment, following the purchase of many additional units, brought the realization of its application in development for wide work and for pillar withdrawal. Time has brought improvements in the detail of construction; the ratchet or control device has changed, as has the rack pan, otherwise known as the feed pan, and the shovel.

In January, 1928, the Joy 4-BU loading machines at Hanna were replaced through the purchase of the modern Joy 5-BU machines. Twelve 4-BU machines were replaced by seven 5-BUs. In the meantime, the practice at Hanna had embodied the use of the large Vulcan two-drum scrapers in the lower

The shaking conveyor does well under bad roof conditions and in close timbering

levels of the mines where spalling ribs made the operation of the Thew and Joy machines hazardous. The driving of the long planes up the 17-degree pitch has been taken over by the shaking conveyors and duckbills. A new adaptation, known as the Button Conveyor, has been introduced to bring the coal from the discharge of the shaking conveyors down to the level, from which the plane development is started. The Button conveyor is an underground adaptation of the retarding conveyors used in Kentucky and West Virginia, to bring coal from pit-mouth to preparation plant.

Due to the frequent faults encountered at Hanna it is necessary to drive a great deal of rock tunnel work. For loading muck in the rock tunnels, the Butler compressed air shovel was introduced in 1927. In this connection occurred the problem of sinking slopes in coal varying in pitch from four degrees to 17 degrees. Several hundred feet of slope sinking was done by the Butler shovel, but inasmuch as this required the transmission of compressed air, the Butler shovels are now assigned to rock tunnel work only, where compressed air is essential for the drilling of shot holes. Slope sinking has been carried on through the use of the old Joy 4-BU and also through the use of pit car loaders, of the Northern and Jeffrey Manufacturing Company type, such as are now used so extensively in the coal fields of Illinois. The sinking problem is unsolved at the present time and additional research can undoubtedly be made with profit.

In changes of operation so considerable as to have taken 60 percent of the loading from hand shovelling to mechanical devices, it will instantly occur to people familiar with coal mining in the United States that the workers of the mines, the labor, must have played an important part. This is true in no less measure in the mines of The Union Pacific Coal Company than in the other coal fields of the continent. When we entered upon the introduction of mechanical loading devices, it was realized that the workmen of the mines would feel that many of their body would be displaced. The announced policy which has been carried out, painstakingly and carefully, was and is that no mine workman shall lose his opportunity to earn through the introduction of mechanical loading devices. It was possible to do this because of the practice enduring for many years of filling up the mines in the early fall with floating labor for the winter run. This labor automatically departed in the spring, of their own free will, to be employed on roads, in the harvest and other open air work. In the spring of 1926, 1927 and 1928, when the floating labor departed no men were employed to fill their places and no additional men were employed for the fall run.

It has been observed that the attitude of the workmen bas been somewhat negative toward the larger and more complicated types of machines and that they more readily accept the pit car loader and conveyor types. One of the chief reasons for this attitude, it is believed, is because the workmen grasp easily the use and performance of the simpler type of device. Ultimately they carry on very nicely with all of the machines, including the more complicated types. Today the majority of the men own automobiles and use labor saving devices in their homes. This plays its part.

Summary

From the fall of 1923 to the fall of 1929, six years have passed, during which the mechanical loading program has carried on to the status indicated in the accompanying tabulation. The outstanding thoughts, as the result of the past six years experience, occur as follows:

The trial scraper, home manufactured, in the laboratory area

(1) The safety of the men, which is the first consideration, is better cared for when they are working with the mechanical loading devices under the immediate supervision of properly qualified foremen.

(2) It is not necessary to change the mining method, that is to say, the room and pillar, longwall, or other method in use. There are plenty of machines for loading coal. Find the machine best adapted to the method of mining by which the property is being worked.

(3) In planning the development and operation of a new mine where the characteristics of the coal bed are known, there now is sufficient information, based on experience available, to enable one to proceed properly.

(4) Mechanical loading permits of a gratifying concentration of producing territory.

(5) Haulage, while it must be good, is simplified, as are also ventilation, drainage and the furnishing of supplies to the face (very important).

(6) Economies in timbering are an important adjunct to mechanical loading.

(7) Morale of labor is much improved under mechanical loading conditions. Men work together in gangs and they feel better.

THE UNION PACIFIC COAL COMPANY

Number of Employes, Total Tons Mined and Tons Loaded by Mechanical Loaders
Total Investment for, and Present Value of Mechanical Loaders for the Years 1923, 1924, 1925, 1926, 1927, 1928 and 1929.

	1923	1924	1925	1926	1927	1928	1929
1. Total number of employes*	3,034	2,770	2,486	2,241	1,915	1,838	1,845
2. Percentage, using year 1923 as 100 percent	100	91.3	81.9	73.9	63.2	60.7	60.8
3. Decrease in number of men (total)	.....	264	548	793	1,119	1,196	1,189
4. Yearly decrease in men	.....	264	284	245	326	77	7†
5. Total coal loaded (system)	3,241,104.85	2,821,677.80	2,779,064.54	2,776,245.45	2,750,430.20	2,927,390.00	3,060,632.25
6. Mechanically loaded coal (system)	107,693.00	161,245.00	265,432.00	601,611.15	1,107,775.85	1,501,578.00	1,774,279.65
7. Percentage of mechanically loaded coal	3.2	5.7	9.6	21.7	40.3	51.3	58.0
8. Cumulative capital expenditure for mechanical loading machines‡	$41,705.23	$53,236.32	$89,372.25	$205,991.44	$327,155.18	$429,255.72	$482,635.17
9. Present value mechanical loading machines (depreciated)	$23,349.77	$28,434.68	$34,026.19	$144,742.48	$217,410.69	$259,232.97	$245,392.61
10. Yearly purchase of new loading machines	$11,427.22	$11,531.09	$36,135.93	$116,619.19	$121,163.74	$102,100.54	$53,379.45
11. Capital expenditure per ton of mechanically loaded coal (8÷6)	$.387	$.330	$.291	$.343	$.295	$.286	$.272
12. Investment, present value per ton of mechanically loaded coal after depreciation (9÷6)	$.217	$.176	$.128	$.241	$.197	$.173	$.138

	1923	1925	1927	1928	1929
Equipment purchased	2 4-BU Joys 4 Thews‡ 1924 2 4-BU Joys	8 4-BU Joys 1 Eickhoff 1926 7 Vulcan scrapers 1 Goodman scraper 6 Eickhoffs	2 Butler shovels 7 M & C conveyors 6 5-hp. Eickhoffs 5 15-hp. Eickhoffs 12 25-hp. Eickhoffs	5 5-BU Joys 12 25-hp. Coscos 1 Jeffrey pit car loader 5 Northern loaders	2 5-BU Joys 6 25-hp. Coscos 16 Northern loaders 1 Vulcan shaking conveyor

* Exclusive of General Office.
† Increase over 1928.
‡ 4 Thew shovels purchased prior to 1923 included.

LOCATION OF MECHANICAL LOADING UNITS AS OF SEPTEMBER 30, 1929.

	Rock Springs	Reliance	Winton	Superior	Hanna	Total
Goodman	1	..	..	..	..	1
Vulcan (scrapers)	4	..	1	..	2	7
Vulcan (shaker)	..	..	..	1	..	1
Eickhoff	11	1	2	14	2	30
Cosco	4	2	12	..	..	18
Mavor & Coulson	..	..	..	7	..	7
Northern	12	3	..	6	..	21
Jeffrey	..	..	..	1	..	1
Joy 4-BU	..	..	7	..	..	7
Joy 5-BU	..	..	..	..	7	7
Thew	..	..	..	..	3	3
Butler	..	..	..	..	2	2
Total	32	6	22	29	16	105

6 5-hp. Eickhoffs operating as auxiliaries to other conveyors.
11 Northern loaders in Rock Springs No. 8 Mine, 5 of which are operating alone, 6 are used with Eickhoffs when required.
1 Northern loader on ground at Rock Springs but not installed.
3 Northern loaders operating with Eickhoffs at Reliance.
5 4-BU Joy loaders at Winton not operating.
Butler shovels at Hanna operating in rock work.
8 scrapers.
55 shaking conveyors (large and small).

History and Development of MECHANIZ

Geology of field—description of mine and seam—early experiments with cutting and loading—present status including shop practice, handling material, and training men for mechanical supervision

THE HANNA coal measures lie entirely in the Tertiary Geological period, the measures containing coal being designated as the Hanna series. This series is composed of alternate layers of sandstone and shales all of which are very weak and not self supporting. The entire field is very badly faulted and in many cases has been subjected to severe folding and horizontal strains. This condition makes the economic mining of these measures very difficult on account of the large amount of rock tunneling required; also the rapid changes of pitch in parts of the basin complicates haulage and mine layout. The coal is lignitic in structure and of comparative weak compressive strength; this coupled with very rapid increase of cover makes the mining of lower measures very troublesome due to bumps and spontaneous combustion. While the middle portion of each seam is comparatively free from sulphur the upper bench in all cases contains free sulphur which causes spontaneous combustion wherever this top measure is broken.

Figure 1 shows a general cross section through the measures now being worked.

Showing chunks in top coal pile.
5 BU. Joy Loader

Sullivan cutting machine in pitching place

The No. 1 seam has been almost entirely worked out in the Hanna Basin and the present workings are now all in the No. 2 seam. This has a thickness of 32 ft. No. 2 mine has been working in this seam since 1889 and is almost worked out. No mechanical loading was ever attempted in this mine. No. 4 mine was opened in 1911 and was laid out for hand operations as no mechanical loading was contemplated at that time. Many millions of tons remain to be mined from tbis seam, however, and the plans at present are to mine this entire reserve by means of mechanical loaders of various types.

Mine Layout and Description

Figure 2 shows the mine map of No. 4 mine as of December 31, 1928. From April, 1911 to December 31, 1928, there were 4,462,169 tons mined and it will be noted that the present area covered by these workings is very small as compared with this tonnage. This gives one some faint idea of the enormous thickness of the deposit.

No. 4 mine was laid out in accordance with what was at that time considered good mining practice, and, for a standard hand operation of that day was quite satisfactory. Large barriers could not be left with any economy in the hand mining operations as yardage charges were always excessive in this field and

* Superintendent, Hanna Mines, The Union Pacific Coal Company.

TION at HANNA MINES

By O. G. SHARRER *

progress was so slow that where large barriers were left the investment in entry development soon became excessive. Rapidity and cheapness of development now makes it possible to leave almost any reasonable size of barriers and these barriers due to the possibility of concentrating loading machines makes for a very economical operation when the retreat of a mine is started.

Haulage entries were originally laid out to care for comparatively slow haulage from hand loading and have not been suitable for the concentrated haulage necessary from mechanical loading. The plan of mechanical mining has been adopted to these conditions in so far as possible and the information gained will permit the planning of any new operations in such manner as to eliminate practically all of these difficulties.

No. 4 mine workings are cut by three major faults which necessitate the driving of an average of 700 ft. of double tunnel or approximately 1,800 ft. of single rock tunnel to get through them on each entry. This rock work has been very expensive and naturally the plan has been to cut these faults in as few places as possible. In each case a panel has been projected to work out each section of coal between faults and in some cases this has caused the rooms to be very long, in some cases over 1,000 ft. In low coal this would be very uneconomical but in this particular seam this method has worked out as an advantage for machine loading. Our experience to date shows that rooms work best when planned for a depth of from 800 to 1,000 ft.

EARLY EXPERIMENTS WITH MACHINES OF VARIOUS KINDS

When this mine was opened in 1911 no attempt had ever been made to undercut this coal by any type of machine and all coal was shot from the solid. This practice was very undesirable from a safety standpoint and also made a very poor quality of coal, particularly from narrow places. No chain machine of that date was successful in cutting pitching coal so that the first attempt to mine this coal was by means of a Radialax post puncher. This machine cut in the top and made a very good job of cutting but was very slow and also was subject to all known kinds of mechanical and electrical failures; this coupled with the fact that the miners did not take kindly to any kind of mining machine made the successful operation of these punchers very difficult. After a long trial period and much grief the machines finally worked well enough to make a fairly good entry driving machine and were worked until they were worn out.

At about this time, 1912, the Sullivan Machinery Company had developed their CE7 machine to a point where they could recommend its use in pitching seams and two machines of this type were purchased. When one sees how easily the coal is undercut today they can have no idea of the difficulties encountered when these machines were introduced. Practically no data was then available as to bit shapes, chain lacing or speed and we had no idea of what type of feed would be necessary to cut this coal. We had no machine runners and runners imported from other fields knew nothing about cutting pitching coal.

We had not the faintest idea of what to expect from these machines and the rank and file of miners were, as usual, opposed to their installation. All in all the introduction of chain machines for undercutting presented a much more difficult problem than the introduction of loading machines at a later date. We learned to operate these machines by tearing them up and rebuilding them until everyone around the plant knew every piece of a Sullivan CE7 by sight and knew just where it went and why. Our own men finally learned how to cut our coal and from then on machine undercutting has given very little trouble; in fact, the cutting has become so simple a step in the entire operation that we are prone to forget that we ever did have any trouble from this source.

When the undercutting of the coal was finally successful the ground was then prepared for the introduction of a loading machine if such machine had at that time been available. However, at that time, 1914-1915, no loading machine was even contemplated for men were plentiful, labor was cheap and tonnages could be maintained easily without recourse to additional machinery.

Changing conditions in 1915 due, in some part, to the World War, caused a labor shortage that made urgent demand for some sort of mechanical aid to production. Much thought and study was given to the possibilities of various coal and rock handling devices but no machine which primarily designated for such service was then available. After a very extended study of the entire subject it was found that the small Thew shovel was apparently the only machine that had been developed to an extent that would justify its introduction.

Thew shovels were therefore purchased and put to work in 1916 in an experimental way. This shovel could work very easily, as heights of 26 ft. were easily obtainable and the problem of sufficient clearance did not enter into the operation.

No one ever seems to be lucky enough to hit the correct solution of a problem the first time it is attempted and the first attempt to load with the Thew was rather stupid when viewed in the light of our later experience. We could not vision taking a portion of the seam and leaving top coal for the Thew operation, so an attempt was made to take a full face of about 20 ft. and cut and prepare Thew coal the same as for hand loading. Cutting and blasting this face of coal proved to be impossible as the face was so high drilling could not be performed in any safe manner and the cutting machine was under a tremendous handicap as it was quite frequently covered up by the face turning over.

After a very short period of experiment with the full face the Thews were put loading top coal from places where the bottom 7 ft. had been taken out by hand miners. This worked out very well and the Thew operation has been changed very little since that time.

First successful loading with Thews started in the latter part of 1916 and the various difficulties of blasting, car service, and maintenance were gradually eliminated. The hardest problem to solve for Thew loading was the proper blasting of the top coal so that the coal would not come down in lumps which the Thew could not handle. This still

MAIN SLOPE #2 MINE
FAULT AREA
FAULT
FAULT AREA
FAULT
FAULT AREA
FAULT
MAIN
BOARD
BELT
SLOPE
NORTH
ENTRY
LEGEND
Arrows indicate direction of air currents
Overcasts shown thus X
Regulators — R
Stoppings — S
Curtains — C
Doors — D
Dust Barriers — DB
No. 4 MINE
HANNA
WYOMING
T. 22 N. R. 81 W.

FIGURE 2

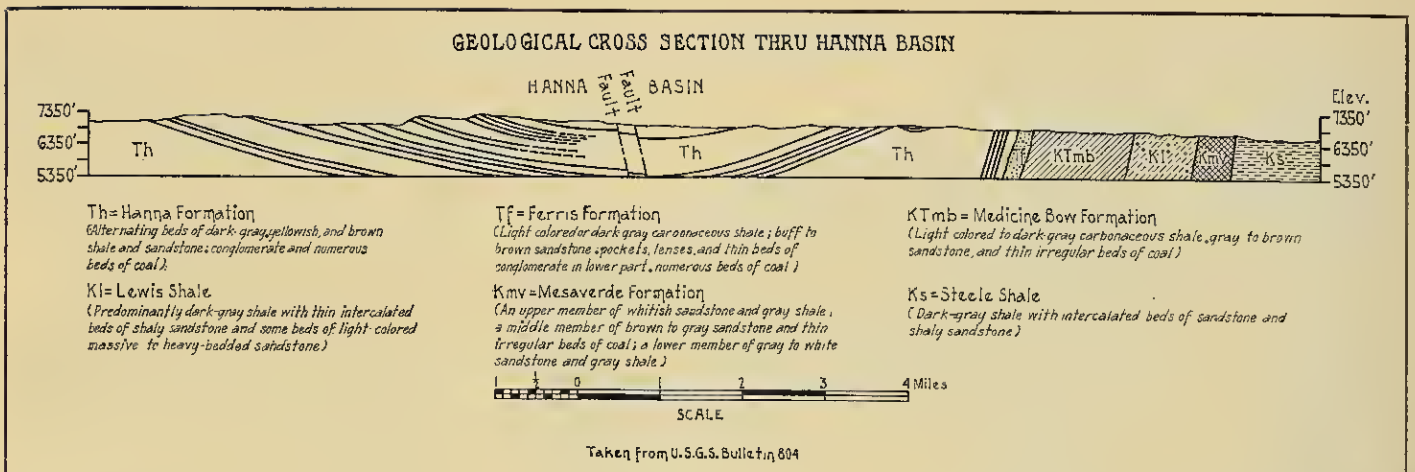

GEOLOGICAL CROSS SECTION THRU HANNA BASIN
HANNA BASIN
Fault
Fault
7350'
6350'
5350'
Elev.
7350'
6350'
5350'
Th
Th
Th
KTmb
Kl
Kmv
Ks
Th = Hanna Formation
(Alternating beds of dark-gray, yellowish, and brown shale and sandstone; conglomerate and numerous beds of coal.)
Kl = Lewis Shale
(Predominantly dark-gray shale with thin intercalated beds of shaly sandstone and some beds of light-colored massive to heavy-bedded sandstone.)
Tf = Ferris Formation
(Light colored or dark gray carbonaceous shale; buff to brown sandstone, pockets, lenses, and thin beds of conglomerate in lower part, numerous beds of coal.)
Kmv = Mesaverde Formation
(An upper member of whitish sandstone and gray shale; a middle member of brown to gray sandstone and thin irregular beds of coal; a lower member of gray to white sandstone and gray shale.)
KTmb = Medicine Bow Formation
(Light colored to dark-gray carbonaceous shale, gray to brown sandstone, and thin irregular beds of coal.)
Ks = Steele Shale
(Dark-gray shale with intercalated beds of sandstone and shaly sandstone.)
1/2 0 1 2 3 4 Miles
SCALE
Taken from U.S.G.S. Bulletin 604

FIGURE 1

presents some difficulty but a careful study of placing of holes and different kinds of powder has cut this source of delay to a negligible factor. When the Thews got underway it was soon found that rooms could not be advanced rapidly enough by hand metbods to keep the Thews in continuous operation and a search was started for a machine that would advance the rooms in the bottom bench rapidly enough to keep the Thew shovel in continuous operation. The Joy 5-BU has proved to be the answer to the room driving question and since their installation the Thew shovels have had a continuous supply of coal.

No. 4 mine is now operating at practically 100 percent mecbanical loading. The only hand loaded coal being track clean-up and some coal from room necks to allow the Joy to get in the clear of the panel. With the shaking conveyor all of this room neck coal is being loaded mechanically which leaves only the track cleanings to be loaded by hand.

This mine has proven that 100 percent mechanical loading is not only possible but that it is the most economical metbod by a very large margin. Every kind of place can now be loaded out by some type of machine and at much lower cost than by hand methods.

Shop Practice on Maintenance and Repair

The maintenance and repair of the large amount of machinery needed in a mechanical mine requires a much more elaborate shop equipment than is customary at a hand plant. Loading machines are quite complicated and require high calibre mechanics to repair them. Hanna shops are equipped to handle almost any kind of machine work and in addition have a complete welding shop. Both electric arc and acetylene are used and the tendency is to use electric or acetylene welding to replace all riveting and press fits. Worn parts are built up with the electric arc or remachined to proper fits witb a great saving of cost.

The machine shop is in charge of a master mechanic who also has charge of methods and practices in underground repair. The electric shop is in charge of a chief electrician who also directs underground electric repair. All armature winding and motor repair is done in tbe local shop which requires that it be well equipped to care for the variety of work that must be handled. Electric power is generated locally and the master mechanic has charge of the boiler room and all steam using machinery. The chief electrician has charge of the turbine room and all electric equipment. The master mechanic and chief electrician keep in close touch with the inside mechanical loader foreman so tbat they are always informed concerning needed repairs.

In almost all cases complete assemblies for the various units are kept in readiness at the main shops and when they are needed underground, the inside loader foreman gets into immediate communication with the main shop and the part needed is sent by truck and gets into the mine with a minimum of delay.

Handling of Material

Tbe carrying of exceptionally high priced repair parts for mechanical loaders runs the material balance up beyond the amount necessary in hand mining. If the material balance is not to get out of line a very careful check must be kept of this department. When a machine is starting out, naturally, one can not tell what repair parts are necessary and the tendency is to carry an excess of repairs. However as the machine works into form it is found that a certain number of parts are subject to failure; these parts must, of course, be carried in stock but only one of each is necessary as replacements can now be obtained in a comparatively short time.

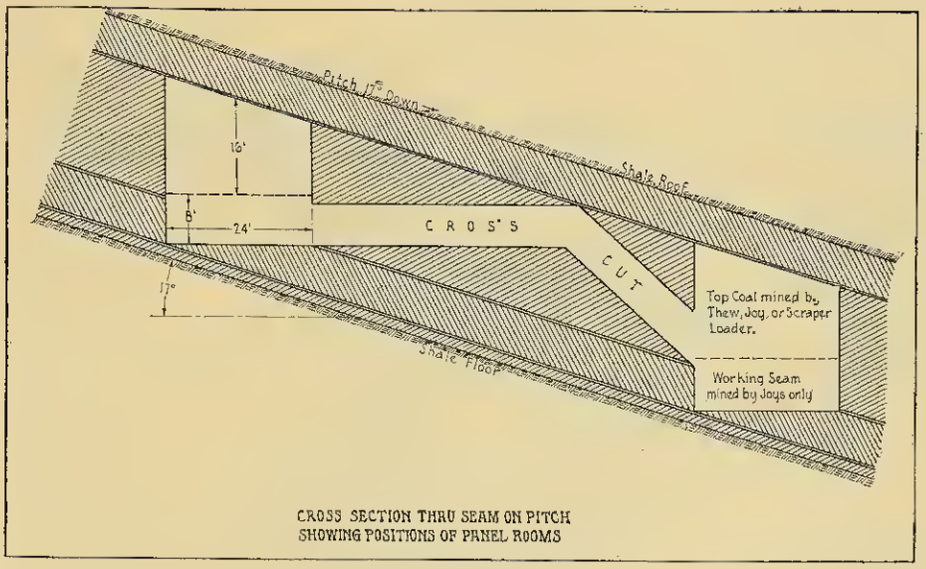
The practice at Hanna mines at tbe present time is to carry a replacement for eacb part that breaks frequently, only one part being carried in eacb case. When this part goes out to the mine tbe material clerk places another on requisition, this affords protection from delay at all times and does not require a heavy investment in idle material. With proper shop equipment many parts can be reconditioned and made as good as new. The greatest saving in this respect can be made through proper use of electric and acetylene welding.

Material charges are a considerable item in the unit cost of machine units and requires very close attention. The present method of cost accounting shows the material charges for each unit and for each shift. This permits a check on material used every day and prevents the cost from getting seriously out of line.

Training Men for Supervision of Mechanical Loading

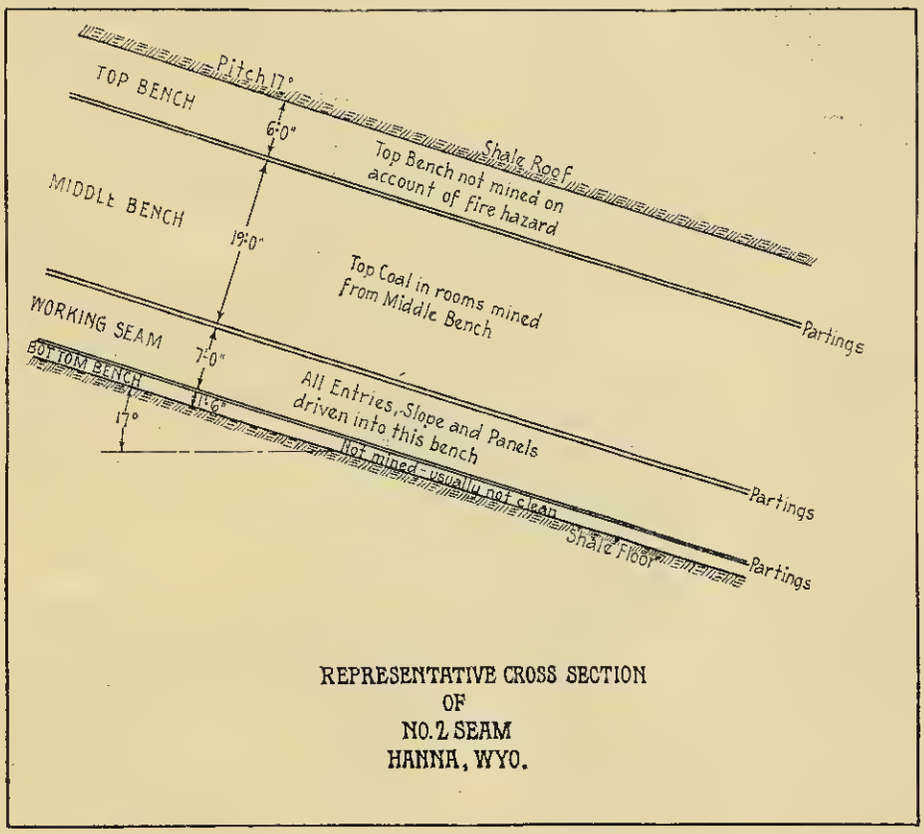
A mechanized mine requires an entirely different kind of supervision than a similar mine operated by hand. In hand operations the supervision consists almost entirely of what one might call personal relations, that is, the contact is with the individual miner, and the official that has the gift of "getting along with men" is almost invariably successful. In a mechanized mine the problem is mucb more complicated, for while the personal problem is more difficult, in addition, there is the problem of supervising the operation of many machine units.

Tbe old-time underground official prided himself on his knowledge of human nature and his ability to handle bad roof, gas, etc., but left the handling of any mechanical problems to some other party. He was not particularly interested in machinery and did not consider a knowledge of its operation as being essential to holding down his job. A knowledge of ventilation, gases, etc., is still essential in a modern mine but



CROSS SECTION THRU SEAM ON PITCH
SHOWING POSITIONS OF PANEL ROOMS

FIGURE 3



REPRESENTATIVE CROSS SECTION
OF
NO. 2 SEAM
HANNA, WYO.

FIGURE 4

this knowledge alone is not enough. In addition to the old line mining technique the modern mine official must have a general knowledge of the various machines in his charge. He must be "machine minded" to the extent that he sees his mine in complete relation to the machine and not as a separate unit.

In the first inception of machine loading this situation was understood and the immediate solution of the problem was to allow the old line mine foreman to have charge of the ventilation, safety, personal relation, etc., and the machines were put in charge of another man who had charge of their operation. This was the only solution possible at that time and is true to some extent even now for there are not enough machine-minded foremen to take charge of all mechanical mines.

Any system, however, that leads to a division of authority and responsibility is not proper and can not long survive. A coal mine during the operating shift resembles a ship at sea, the mine foreman taking the rank of captain, and when a ship leaves port the captain has absolute authority over every one on board, even the owner of the vessel having no authority to issue orders. The authority of the mine foreman should be as absolute as that of the ship captain but in order to exercise this authority the foreman must represent the very best of his profession. In order to be able to exercise this absolute authority over all men in his charge the foreman must have a general knowledge of all the various phases of the operation to such extent that he can intelligently direct all of his subordinates. This does not mean that he must be an expert electrician, for instance, but that he should have the general knowledge of electricity that can be acquired by any layman who is interested enough to give the matter some study.

In many cases the older foremen were lukewarm or even actually opposed to machine loading and naturally the new methods could not succeed until they were replaced by men having a different attitude of mind. This led in many cases to the promotion of young men from the ranks of motormen and chain machine runners, these men never having given much thought to the position of foreman. Some of these men have been very successful while others have failed but the experiment as a whole has proven that men who come up through the positions of machine runner, loading machine operator, machine boss, etc., make the best foremen for a mechanical operation. In the past men of this kind were not obtainable but as mechanization grows older there is an ever increasing number of young men who have grown up with machines who are available for official positions. Some success has been attained by taking graduates from the mining schools and training them directly as mine officials, however, in this connection there is no more reason to expect a mining engineer to become a successful official merely because he has a diploma than to expect a good machine runner to be a success. The factors of personality, honesty, and dependability which are so essential in an official are not the product of a college but are traits inherent to the man himself and are just as liable to be the property of a good timberman as of a college graduate.

There are never enough good officials to fill all jobs so it is one of the duties of management to be ever on the alert for possible talent. A man suspected of having ability along this line should be observed very closely and when an opportunity arises should be given a chance in minor capacity. He should not be petted or pampered in any way, in fact, his treatment should be fairly severe in order to find out if he is the type that can stand punishment. When a man gets a (*Continued on page* 37)

MECHANICAL Operation at Hanna Mines

By J. V. McCLELLAND *

Descriptions of operations with large electric shovel, mechanical loaders, rock shovels, scrapers and conveyors—Mechanical loading on 100 percent basis—Slope driving in heavy pitch and thick coal—Description of drainage and ventilation

THE Union Pacific Coal Company's Hanna mines are located adjacent to the town of Hanna, Wyo., which is on the main line of the Union Pacific Railroad about 135 miles west of Cheyenne.

Mechanical loading in the Hanna No. 4 mine dates from January, 1916, at which time the first Thew shovel was put into operation. Another unit of similar type was installed in July, 1917, and during 1918 two more shovels of the same make were introduced. Two of these loaders are still in operation. The Thew shovel is an electric driven machine of the swinging boom type similar to those used in strip pit mining or railroad grading work. Since these shovels require a minimum of 15 ft. overhead clearance their use in underground mining is prohibitive in ordinary mining operations. Only the very unusual conditions of roof and height of coal prevailing in the Hanna mines, when the seam is 32 ft. thick, makes their use possible.

Results obtained with Thew loaders showed that mechanical loading could be carried on successfully in the Hanna mines providing the proper type of equipment could be obtained. To carry out this policy of mechanizing the mines two Joy loading machines of the 4-BU type were installed during 1923. Results obtained with these machines led to the installing of more of the same type during the years 1924 and 1925 until 12 of these loaders were in operation. These machines were only partly satisfactory as they were not built heavy enough to withstand the hard usage to which they were subjected. The 5-BU type of Joy loader was introduced in 1928, and were so far superior to the smaller type that the number of machines was increased until at present there are seven of these in operation. The 5-BU type is of heavier construction, and is better adapted to Hanna conditions.

In line with the Union Pacific Coal Company's policy of mechanization it became necessary to install some type of loading machine suitable for entry driving. To this end an Eickhoff shaking conveyor was installed in 1927. This conveyor was equipped with a "Duck-Bill" at the front end to eliminate shoveling on the pans. This "Duck-Bill" was designed by the Rock Springs Loader Co., and has proven very satisfactory. About 90 percent of the coal is loaded without shoveling by using the "Duck-Bill" and swivel pan arrangement. At present there are two of these units in operation and are used for driving panel planes to the raise on a pitch of from 12° to 15°. Experience shows that the shaking conveyor is capable of advancing these planes about 400 ft. with one setting of the drive. As these conveyors advance up the pitch some means of handling the coal from the end of the conveyor must be provided. In order to avoid installing hoists to supply cars to the conveyor a very practical auxiliary conveyor has been built by the resident master mechanic. This is a "button conveyor" with a series of "buttons" each two inches in diameter and two inches long fastened on a ⅝-in. steel hoisting rope. This runs in a 16 gage galvanized iron trough. The drive for this conveyor is a small hoist with a grooved sprocket riveted on the drum driven by a 20-hp. motor. The shaking conveyor discharges into a bin through which the button rope passes, thus conveying the coal to the loading station on the entry at the foot of the panel. The present "button conveyor" is about 1,400 ft. long, and has proven a very efficient installation.

In order to determine the loading machine best adapted to Hanna conditions a type of scraper loader was introduced in 1926. The motive power for the scraper is derived from a double drum hoist manufactured to Union Pacific Coal Company specifications by the Vulcan Iron Works, of Denver, Colo. Two types of scrapers are used, one of the open end box type of company manufacture, and another of the Sauerman "Crescent" type. The use of scrapers is limited at Hanna to the loading of what is known locally as "top-coal." This top seam is about 19 ft. in thickness and is removed by second mining. The operation of scrapers is not continuous at the present time, but are used only when maximum production is required.

Another type of loading machine, known as the Butler shovel, is also used in Hanna No. 4 mine. This is an air-driven machine and was adapted from the metal mines for rock work. The presence of a series of faults in the Hanna seam necessitates the driving of rock tunnels at fairly regular intervals, hence the need for a machine of this type. Air is supplied by Sullivan compressors, Type WK, size 10 in. by 10 in., installed at locations convenient to the operations of the shovel. The machines are well adapted to the work, have low maintenance cost and are an economy on account of labor saving. No attempt has been made to load coal with this machine, as the supplying of air is not convenient for any extensive operations.

Mechanical loading is now on practically a 100 percent basis. The only coal loaded by hand coming from room necks being opened up for Joy loaders. At the present time the No. 4 mine is producing 1,700 tons of coal per eight-hour shift, the average production per unit being: Thew shovels, 200 tons; Joy loaders, 215 tons; and shaking conveyors, 55 tons. In the use of shaking conveyors for development work it is of more importance to obtain yardage than high tonnage. The scraper loaders when

* General Inside Foreman, The Union Pacific Coal Company.

Figure 1 (left).
Thew shovel

Figure 2 (left.)
Joy No. 5 at face

operating will load on an average 270 tons of coal per shift.

The coal at Hanna is a good grade of lignite rated at 11,500 B. t. u. Tbe average section of the seam is as follows:

Coal, 6 ft.
Thin parting.
Coal, 19 ft.
3-in. bone or rock parting.
Coal, 7 ft.
Coal and bone, 1 ft. 6 in.
Clay bottom.

The partings between the coal vary in different parts of the mine, and become thicker going to the dip, particularly the 3-in. band between the 7 and 19-ft. benches. The coal dips to the southeast, the average pitch being 17 degrees. A series of dip faults are encountered as the entries are advanced. Overlying the coal seam is a band of shale of variable thickness, but averaging about 8 in. Above this shale is a sand rock of considerable thickness.

The mine is opened by means of a slope which crosses the pitch at an angle of 25°. Parallel to this slope are driven the manway and return air course. Development work is by means of two parallel entries driven on motor grade along the line of strike. Panel entries are driven off these cross entries and their location is determined by the faults encountered as the headings advance. In some cases only one panel entry is driven in the section between two faults. Rooms are turned off these panels and may attain a depth of 1,000 ft. before reaching the fault. Panel planes are advanced to the raise by means of shaking conveyors. These panels are driven in the 7-ft., or bottom seam. Rooms turned off these panels are driven level to permit better operation of mechanical

Figure 3. Joy No. 5 moving on panel

Figure 4. Button conveyor—loading end

Figure 7 (right). Eickhoff at face with "Duckbill," high coal type

loaders. When these rooms are widened to 24 ft., which is standard, the high rib is on the bottom of the 7-ft. seam, and the low rib is 3 or 4 ft. up in the 19-ft. seam. (See *Figure 3.*) All panel planes are driven in the bottom or 7-ft. seam. Cross entries are driven in the bottom of the top or 19-ft. seam. By this method the rope haulage on planes does not interfere with motor haulage on the cross entries.

Mining in rooms is two distinct operations. The room is advanced to the fault in the bottom coal by means of Joy loaders, and the top bench is then removed by Thews, Joys, or scraper loaders. In the recovery of top coal by means of Thew shovels or Joys the coal is shot down ahead of the machine for a distance of about 75 ft. Care must be taken not to have more than this amount of broken coal on account of the pile firing before being loaded out. The advance of a loading machine in these piles averages approximately 10 ft. per day. After the top coal has been recovered the Thew shovels are moved back under their own power to a cross-cut near the neck of the room which has been so driven that it is on the regular pitch of the seam. When the shovel reaches this cross-cut it is snubbed down the pitch to the room below by means of an ordinary block and tackle.

After a Joy loader has cleaned up a room in the bottom coal it is moved to a position over the track by means of the caterpillar tractor upon which it operates while loading. It is then run up on wooden blocks to allow the wheels to be replaced for travel along the room track to the panel. After reaching the room neck the machine is moved to a new location by the panel hoist. Connection between loading machine and

Figure 8 (right). Centrifugal pump room

Figure 5. Button conveyor bin

Figure 6. Button conveyor, tail sheave

Figure 9. Room showing face and little seam of rock between first and second cuts

panel trip is made (See *Figure 3*) with a short piece of hoisting cable. The length of time required for this move varies with the length of the rooms. An average of 30 minutes is required between rooms 500 ft. in length. This delay would be eliminated in flat seam work where machines could be moved between rooms by traveling through cross-cuts near the face.

In development work all coal is undercut with a Sullivan CE7 mining machine equipped with an 8-ft. 6-in. cutter bar. All mining machines have water on the cutter bars while in operation to eliminate the hazard of dust. Drilling is done with the Van Dorn one-man type drill and use a 1¼-in. bit. Where the coal is exceptionally hard it becomes necessary to mount the drill in a stand, but under ordinary conditions the holes are "breasted." Shooting is done with permissible powder by certified shotfirers. The shot-firers load, tamp and shoot all holes. On account of the "woody" nature of the coal and the lack of any distinct partings it is necessary to use a large amount of explosive in shooting. An average room 24 ft. wide and 8 ft. high requires 14 holes arranged in two rows across the face. Six sticks of powder are used in these holes and delay caps are used in the lower rib holes. The shots are fired in two rounds; the lower holes first, then the upper. All shots are fired with an electric blasting machine. Coal is cut and drilled on both the day and night shift, but shooting is done at night except when some delay in regular operation makes it necessary to shoot a place during the day shift in order to provide coal for a loading machine. The top coal is shot in three benches, and holes require a slightly heavier charge than in development coal.

Successful mechanical loading depends very largely upon haulage, particularly at the loading machine. Some system must be devised where-by cars are provided the unit without delay to insure continuous operation. A double track arrangement has proven quite satisfactory at Hanna, for by this method car changes can be made quickly and under ordinary conditions an empty car is always at the machine. Horses are used for haulage at the loading machines and to the partings on panel rooms. Haulage on panel planes is by means of electric hoists to partings on cross entries. Electric locomotives are used on cross entries to the main slope partings, and then by steam hoist to the tipple. Experience has proven that good track, properly maintained, and a sufficient supply of cars is absolutely necessary for successful mechanical loading.

Two shifts are employed at the present time. The day shift does most of the cutting and drilling as well as the ordinary maintenance work. Blasting and handling of material is the principal work of the night shift. Some coal is loaded at night in order to provide coal for hoisting at the beginning of the day's run. All panel planes and cross entries under development are double shifted in order to increase yardage. Regular crews are provided for each unit, and units are grouped under the supervision of a unit foreman. The Thew shovels are manned by an operator, one car trimmer, and two drivers. Joy crews consist of an operator, one face man, who is a relief operator, one car trimmer and two drivers.

The shaking conveyors are operated with one operator, one face man, one man at the loading head, and a machine crew of two men. While the shaking conveyor is operating in one heading the machine crew is cutting and drilling the parallel heading. Scraper loaders are operated with one hoist man, one operator, one loading head man, and a driver. In scraper operations the scraper discharges on to a flight conveyor which carries coal through a room cross-cut. The conveyor discharges into a gravity chute at the end of which the mine cars are loaded in the room below.

The drainage in the No. 4 mine is quite simple, as the mine does not make a large quantity of water. In general the drainage is down the pitch to the sump at the bottom of the main slope. From this sump water is pumped by a plunger pump to a sump of larger capacity which may be used as a storage reservoir in case of any derangement of the regular pumping routine. At this sump there is an Allis-Chalmers centrifugal pump capable of discharging 450 gallons per minute. This pump is set at a slightly lower elevation than the sump in order that water will flow into the pump. The water is pumped to the surface in two stages, the lower pump discharging into an intermediate sump about half way up the pitch to the outside. From this second sump the water is discharged at the surface by a pump that is a duplicate of the one at the lower station.

The main ventilating fan is a 20-ft. steam-driven Guibal. Auxiliary electric driven fans are installed on the surface at panels driven to the outcrop. The main slope and manway are the principal intakes, but some air is taken through worked out panels. Each cross-entry is on a primary split, and panels are on secondary splits off the cross entries. Panels are ventilated up the pitch, the air returning through the back entry at the top end of the panel. All underground stables, motor-generator set rooms, and pump rooms are on separate splits.

The tipple is of the cross-over type, capable of handling 2,000 tons per eight-hour shift. Shaking screens separate the coal into four different sizes of prepared coal. A coal crusher is an important part of the tipple equipment, on account of very large lumps produced in top coal mining. Slate is hand picked on conveyors leading to the crusher.

The unusual coal seam at Hanna presents an interesting problem in mining. The extremely high coal, fairly heavy pitch, presence of some gas, and the number of different types of loading machines in use, makes this operation one that stands in a class by itself in American mining practice. Opened as a hand loading mine, it has been changed to a mechanical operation very satisfactorily.

MINE OPERATION at SUPERIOR

By GEO. A. BROWN *
and F. V. HICKS †

George A. Brown

Description of seam and roof conditions—operation of shaker conveyors with Duckbill and loader in room and pillar system—number of men employed—methods of timbering, haulage and ventilation—sketches of mining system and photography of underground operations

F. V. Hicks

THE Superior mines of the Union Pacific Coal Company are located at Superior, Wyo., which is 25 miles from Rock Springs, Wyo., on the northeastern rim of Baxter Basin. Superior has a population of approximately 2,000, which for the most part are dependent either directly or indirectly upon the coal industry. Two independent companies, besides the Union Pacific Coal Company, are operating mines in this district.

The mines of the Superior district are in the Nos. 3, 1, 7, and Van Dyke seams. The various other seams which are more or less persistent throughout the Rock Springs field have their occurrence here as thin seams or else are excessively dirty.

The Union Pacific mines of Superior were opened in 1906. This group consists of five mines, viz, A, B, C, D, E, three of which are being operated at the present time, work having been temporarily suspended in two of the mines (A and D), in an attempt to concentrate activities, following the introduction of mechanical loading.

* Superintendent, The Union Pacific Coal Company.
† Assistant Superintendent, The Union Pacific Coal Company.

Physical conditions in the Superior district differ materially from those of other districts in the field. The coal has a higher thermal value than the others and is a most excellent steam coal. Due, however, to its friableness, the percentage of lump coal is much lower than that from other districts.

The No. 1 seam, which is most persistent throughout the field and workable in all districts of the field, is here worked by Lower A and C, and D mines. The measures pitch to the northeast, at an angle of 4 degrees (approximately 7 percent), necessitating slope haulage on all main haulageways on the pitch. This relatively gentle pitch of the measures in the Superior district constitutes its only physical advantage in mining operations over the various other districts, as tracks and track layouts are more easily installed and maintained.

Immediately overlying the No. 1 seam is a laminated shale of approximately 20 ft. in thickness. It is the belief of those most familiar with the Superior district that in the raising of the Baxter Basin anticline in some manner the measures at Superior, with their overlying strata, have been and still are subjected to lateral pressure. This lateral pressure tends to weaken the adhesion between the various strata of shale which constitute the major portion of the cover of the various seams.

This geologic condition, which is only encountered in the Superior district, results in a mining condition which is difficult, costly, and hazardous; however, it will be of interest to note that "C" mine, since its opening in 1906, with its particularly bad roof, has suffered fewer fatalities than some of our other mining properties where better roof conditions prevail.

The roof in working places, driven on the pitch in "C" mine, regardless of width, breaks immediately, and unless carried on timbers will cave to an arch. *Figures 1 and 2* will give some idea of this condition. Strike entries are seldom so affected where 18 to 20 in. of top coal is left up. In room work, after the place has been driven up its distance and the roof has taken its initial break, the roof condition in the pillar is always found to be very much better than in the rooms. While it is necessary to carry the entire width of roof in rooms on cross bars using 5 or 6 legs to the cross bar, only props are used in the pillar recovery. The breaking of roof

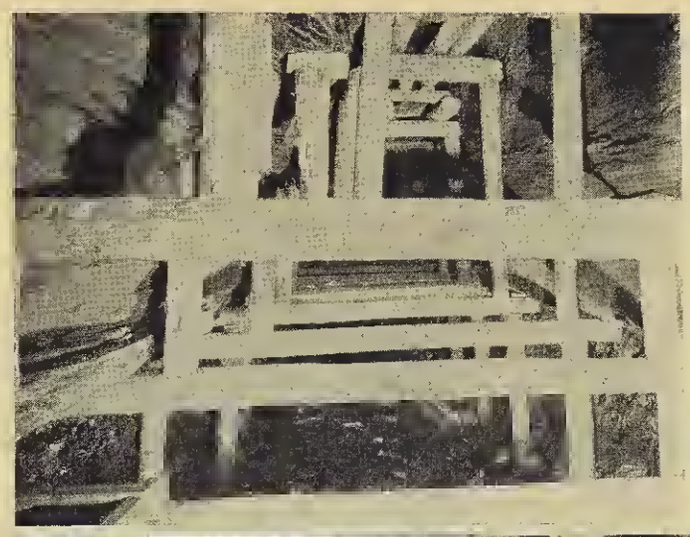


Figure 1 (left). Showing roof cave in a panel slope. Height of coal 7 ft. 6 in. Roof caved to an arch. Width of place 12 ft. "C" Mine, Superior

Figure 2 (left, below). Roof cave in entry. Height of coal 7 ft. 6 in. Width of place 12 ft.

Figure 3 (below). Picking refuse from pan line within the mine. Note gob on left side of pan

in this district. This is removed from the coal within the mine by boys placed along the conveyor pan lines. (See *Figure 3.*)

The Van Dyke seam in places carries a rock band within the seam. This is often 2 ft. in thickness. Above this band there is 5 ft. of clean coal with a good roof, and the mining in sections where this band occurs is carried on above the rock band, taking the 5 ft. of coal only.

Mechanical loading under roof conditions herein described, with most types of loading equipment, is quite generally considered impractical, and truly it would be with the heavy mobile types of loaders on the market today.

in places worked in advance relieves the lateral stresses in the roof, and none of the tendency to break that is encountered in the rooms and entries is found in the pillars when they are being recovered.

The roof in the lower levels of "E" mine acts quite similar to that in "C" mine, breaking in the narrow places either strike or pitch. However, the roof here does not break immediately upon being exposed. It at first gives every indication of being excellent, then, without warning, it may fall. This condition necessitates the placing of crossbars at all times, never allowing the working face to remain untimbered more than 5 ft.; enough to permit a cutting machine to cut the face. Such a roof condition is extremely treacherous, as the tendency always is to neglect the timbering on what has every appearance of being an excellent roof.

The roof condition in "B" mine is quite different from either "C" or "E" mine. Here the stratum immediately overlying the coal is a lenticular shale, which is full of slips and very irregular. Where water is encountered in the overburden, the roof requires extraordinary attention in the placement of timber.

Most of the coal so far mined averages from 7 ft. to 7 ft. 6 in. in thickness, and is for the most part free from impurities that occur within the seam itself. However, there is a clay band, varying from 2 to 8 in. in thickness, which is characteristic of the No. 1 seam

One of the two first Eickhoff shaking conveyor units shipped to the United States was consigned to the Union Pacific Coal Company at Superior. It was the thought of the management to first at-

Figure 6. Low coal Duckbill attached to shaking conveyor. Note use of saddle-jack in supporting lagging before placing of permanent cross-bar

tempt mechanization of its loading operations under what was considered their most difficult condition. If successful here, it was thought it could be made applicable to other mines of the company.

With this introduction of shaking conveyors one fatal—but very common—mistake was made; that was the attempt to operate new machinery, whose operation and adaptability was not understood at the time, in a method of mining which was also new to the district, viz, long-face mining hand shoveling onto the conveyor. Little need be said about this operation, other than that the system failed. Inability to maintain an open working face over any period of time, prohibitive timber costs, and inexperience with the new machinery necessitated the abandonment of the plan, after several months of heart-breaking effort.

The conception, development, and perfection of the McCarty duckbill in the Rock Springs mines of the Union Pacific Coal Company, thus converting the shaking conveyor from a simple transporting machine to a loading and transporting device, proved to be the solution of conveyor operation in the Superior district, as it was found to be unprofitable here to use conveyors as a transporting medium only. Hand shoveling 100 percent of the coal onto conveyors showed no economy over ordinary hand-loading methods in these mines.

The loading equipment of this district consists of 7 Mavor & Coulson shaking conveyors equipped with 25-hp. motors, 6 Eickhoff conveyors with 25-hp. motors, 3 15-hp. Eickhoffs, 5 5-hp. Eickhoffs, 6 Northern conveyors, and 1 Jeffrey pit-car loader. All of the shaker conveyors are equipped with duckbills of the Universal type, which are manufactured by the Rock Springs Loader Company.

The room and pillar system of mining is used exclusively. With the heavy roof conditions that prevail all entries are driven to the boundary and worked on retreat. State laws necessitate that rooms be driven in pairs and crosscuts driven every 50 ft. This necessitates the use of a "swing crew," part loading out one place as the other is being prepared. These crews consist of from five to seven men at the face, depending upon conditions, made up of the following:

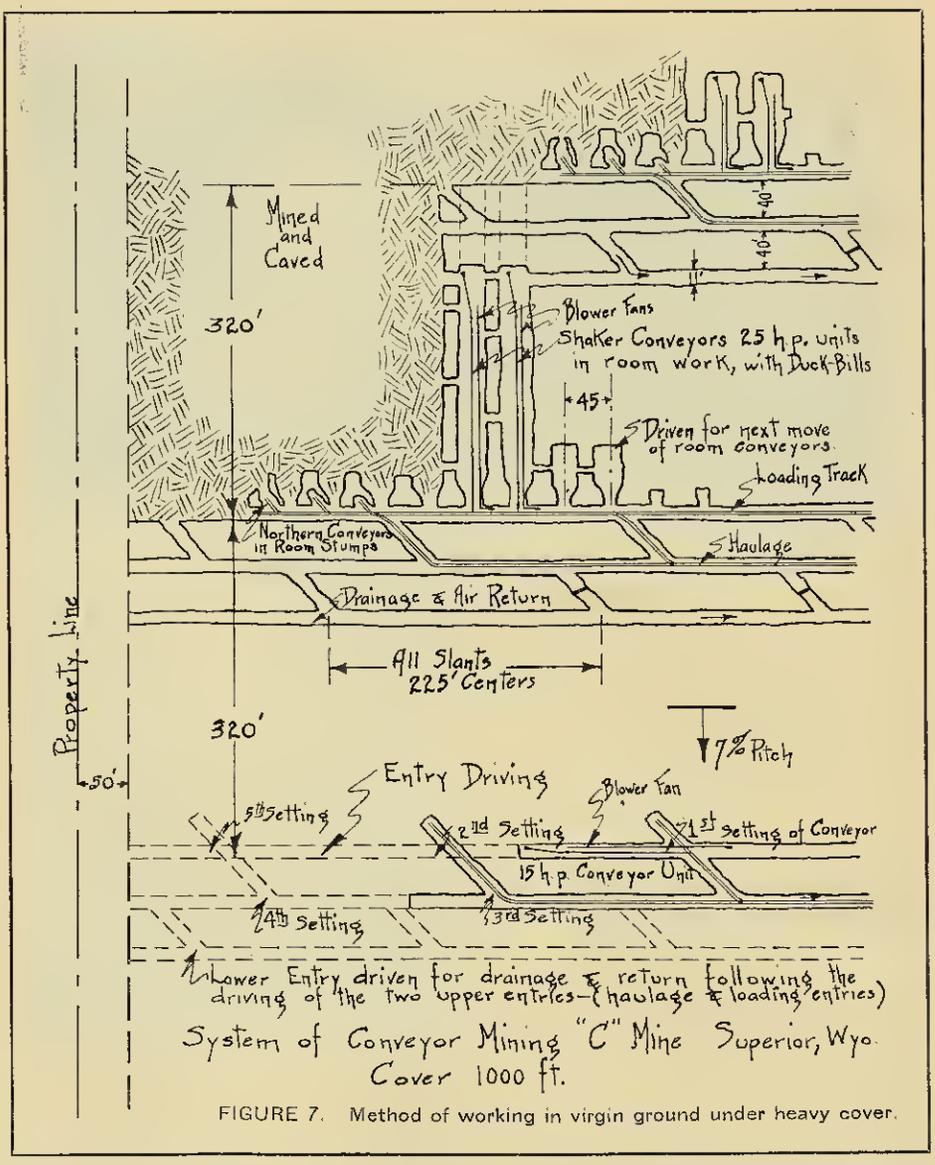


FIGURE 7. Method of working in virgin ground under heavy cover.

Figure 4. Method of timbering in rooms, timbers unbroken

Figure 5. Room timbering, showing broken cross-bars

Figure 8. Loading head of conveyor used in driving entry work on strike of seam. Note slant used for car storage

One duckbill operator, two face men, two mining machine men who also drill the face, two timbermen when needed, and one loading head and haulage man. Such an arrangement permits of steady loading over a considerable period of the day. Much of the work of this nature is in "C" mine, where the cover is approximately 1,000 ft. The rapidity of advance of rooms and pillar recovery, under this heavy cover, alone makes economical mining of this seam possible. Costs under the old system of band loading with its slow progress, necessity for many working places for an equivalent tonnage, track, retimbering, maintenance of clearance for cars, etc., would be prohibitive in this field. As it is, timbering costs—labor and material—often run for individual places as high as 25 cents per ton. Twenty ft. crossbars are used in rooms—room width 22 ft.—placed every 5 ft., with six legs under each crossbar, and lagging used over cross timbers. (See *Figures 4 and 5.*) The face is shot one hole at a time and lagging is immediately placed ahead of the last crossbar. These lagging are temporarily supported by a screw jack having a saddle at the top for the support of a cross or supporting timber. (*Figure 6.*) As soon as sufficient coal can be loaded out the permanent crossbar is set.

The entire fall of coal from the face is loaded out using the duckbill. This is made possible by shifting the center legs of the crossbars as necessity demands, using saddle screw jacks to temporarily support the crossbars when necessary.

The tonnage from these swing places varies, depending upon conditions encountered; however, the average manshift tonnage over a year's period is approximately 12 tons. Labor charged to these units includes all members of the swing crew—face men, timbermen, mining machine men, drillers, blasters—and one-half of the time for the loading head man, the other half being charged to mine haulage. Also all mechanical and electrical labor properly chargeable to the unit.

The swing crew is not the most economical. Single places, having a crew of three men at the face doing all loading, cutting, drilling, blasting, and timbering, produce the cheapest coal. State laws, however, prevent this.

Entries are driven on the strike, maintaining a slight grade favorable to the loads where the floor is regular enough to permit this being done. The three-entry system is used. The two upper entries are both on intake, the lower entry being used for drainage and return. The two upper entries are driven in ahead of the third entry, using one unit only in driving these two headings. State laws permit the driving of entries 300 ft. ahead of the last breakthrough in nongaseous mines, providing either line brattice or blower fans are used. Slants are driven every 225 ft. In moving the conveyor unit ahead after 300 ft. have been driven, it is located at the junction point of slant and entry. The discharge end of conveyor is so placed that the slant can be used for car storage, the empty cars being run in past the conveyor and loaded as they are dropped past, using the pitch to assist in moving the trip past loading end. (See sketch of entry driving showing various locations, and *Figure 8* of loading head on entry.)

The third or lower entry follows the driving of the upper two. One unit is used in driving this entry. The time of starting this third entry is so timed that it will reach the boundary at about the time of the upper two.

The 15-hp. Eickhoff conveyor equipped with duckbill is used in driving all development work on the strike. The slants are driven by the 5-hp. Eickhoffs. These are used discbarging onto the 15-hp. unit, using the same crew but swinging them from entry to slant.

Entries average about 11 ft. in width, and 5 ft. 6 in. to 6 ft. in height, the top coal being left up. A double shift averages five cuts of about 40 ft. advance in 16 hours, machines being equipped with 8-ft. cutter bars.

Small 4-ton locomotives are used in serving conveyor units. Pit cars vary in capacity from 2,200 to 4,000 pounds at the various mines. Since all loading from conveyors is side loading, car capacity does not enter into the scheme of loading as it does with types of loaders and track arrangement necessitating end loading with individual car changes.

Since hand loading preceded mechanization in all the mines at Superior, the general mine layout is largely determined by this previous work. This, while well suited to the methods then in use, are not now well adapted. A large amount of work has been necessary to mine out straggling chain pillars, room pillars, and panels in order to obtain proper roof breaks to free the new work from riding weight. Most of the "easy coal" which is tributary to the Superior mines has been mined, and new work is being forced to deeper cover and more adverse mining conditions.

Little surface preparation is necessary in order to supply a clean, marketable product. All of the output is taken for railroad consumption, and since most of the coal is used for stoker firing, much of the coal is shipped direct to consumer as run of mine. However, provisions have been made for sizing the coal when market demands.

Of the three mines now operating, "B" mine is totally mechanized, about 60 percent of the loading equipment in this mine being double-shifted. "C" mine tonnage is produced both by hand loaders—all of whom are in pillar work—and mechanical loaders, which are double-shifted. The mechanical tonnage representing 65 percent of this mine's output.

"E" mine has as yet but little equipment. This consists of three Northern loaders used in room work and one 15-hp. Eickhoff, equipped with a duckbill, used in driving entry. This equipment, too, is double-shifted.

The total mechanical tonnage from the three operating mines represents approximately 60 percent of the total tonnage mined. As standing pillars are withdrawn, which can be best accomplished by hand-loading methods, additional loading equipment will be installed, ultimately completely mechanizing all loading operations.

MECHANIZATION at ROCK SPRINGS MINES

By T. H. BUTLER *

Mining plan described showing scrapers and Duckbill conveyors on long faces—Chain conveyor at end of face for loading mine cars—Detailed description of equipment and mining practices for all face operations — Entries advance with conveyors — Number of men employed on the loading and preparatory crews — Main line and gathering haulage described

THE desire for increased production and lower costs in the Rock Springs mines made it necessary to change the method of mining, from the room and pillar system of driving the rooms up the pitch, or the panel system of driving panel planes on the pitch with the rooms on the strike. Both of these methods required a large amount of machinery and a heavy gathering expense. In either of these methods of mining the empty cars had to be hauled to the working faces, and, where the rooms were driven up the pitch, hemp ropes were required to lower the loaded car to the haulage entry. This method necessitated the employment of many men and also created a hazard by the ropes breaking and allowing the car to run wild.

During the year 1923 the matter of installing mechanical means of transporting the coal from the working faces to the haulageways, other than by the old and dangerous method, was brought up, and after much thought and a great deal of experimenting, the shaking conveyor and the scraper loader were adopted as best suited to existing conditions. The use of these two types of coal loaders necessitated a change in mining methods from the room and pillar system, and the present system of working the seam in blocks was substituted with the installation of shaking conveyors and scraper loaders.

With this method slopes are driven on the pitch of the seam, and headings driven off the slopes, on the strike of the seam, at intervals of 600 ft. Conveyor ways are driven off the headings up the pitch at intervals of 100 ft. by use of shaking conveyors, equipped with the duckbill originated and patented by F. L. McCarty, mine superintendent of the Rock Springs mines, and his associates. The duckbill has proven efficient and economical, and is the outstanding feature in loading coal with a shaking conveyor. The conveyor ways are 10 ft. wide and 6 ft. high and are driven from the haulage entry to the breaking entry above, a distance of approximately 400 ft. During this advancement the entry is ventilated by the use of small blower fans and flexible tubing. Power for driving the conveyor pans is provided by 25-hp. d.c. motors.

The mining laws of the State of Wyoming permits shooting during the working shift, thereby making it possible under normal conditions to advance the conveyor ways a distance of three machine cuts, or approximately 22 ft. per eight-hour shift. Water is used on the cutter bars of all mining machines, permissible powder, and electric detonators are used in blasting, and electric cap lamps are used for illuminating purposes, all of which tends to lessen the hazards of blasting during the working shift.

The shaking conveyor brings the coal directly to the main haulageway and deposits it in the pit car which stands on the siding, or passing track off the main haulage track. After the conveyor ways are connected with the breaking entry above, the pillar is attacked by the long-face method, a kerf being cut along the entire face, the coal shot as needed, and it is then loaded by the conveyor equipped with the duckbill. In this manner the pillar is reduced until it is approximately 8 ft. in thickness, between the new and old places. The equipment is then moved to the new working place, and the same procedure followed until the coal in all the blocks has been extracted. The entry stumps are then recovered by the use of the shaking conveyor and duckbill, and conveyor pit-car loaders.

In mine No. 8 at Rock Springs, Wyo., where this system is used, the coal seam is approximately 8 ft. in thickness. It has marked cleats, but not very obvious bedding. The conveyor ways are driven directly up the pitch, which is inclined about 8 degrees from the horizontal. The roof on the whole is fairly good, though in places there are large crevices in both the coal and rock, which are filled with white sandrock dykes. Ordinarily props are set at intervals of 6 ft.

* Superintendent, Rock Springs, The Union Pacific Coal Company.

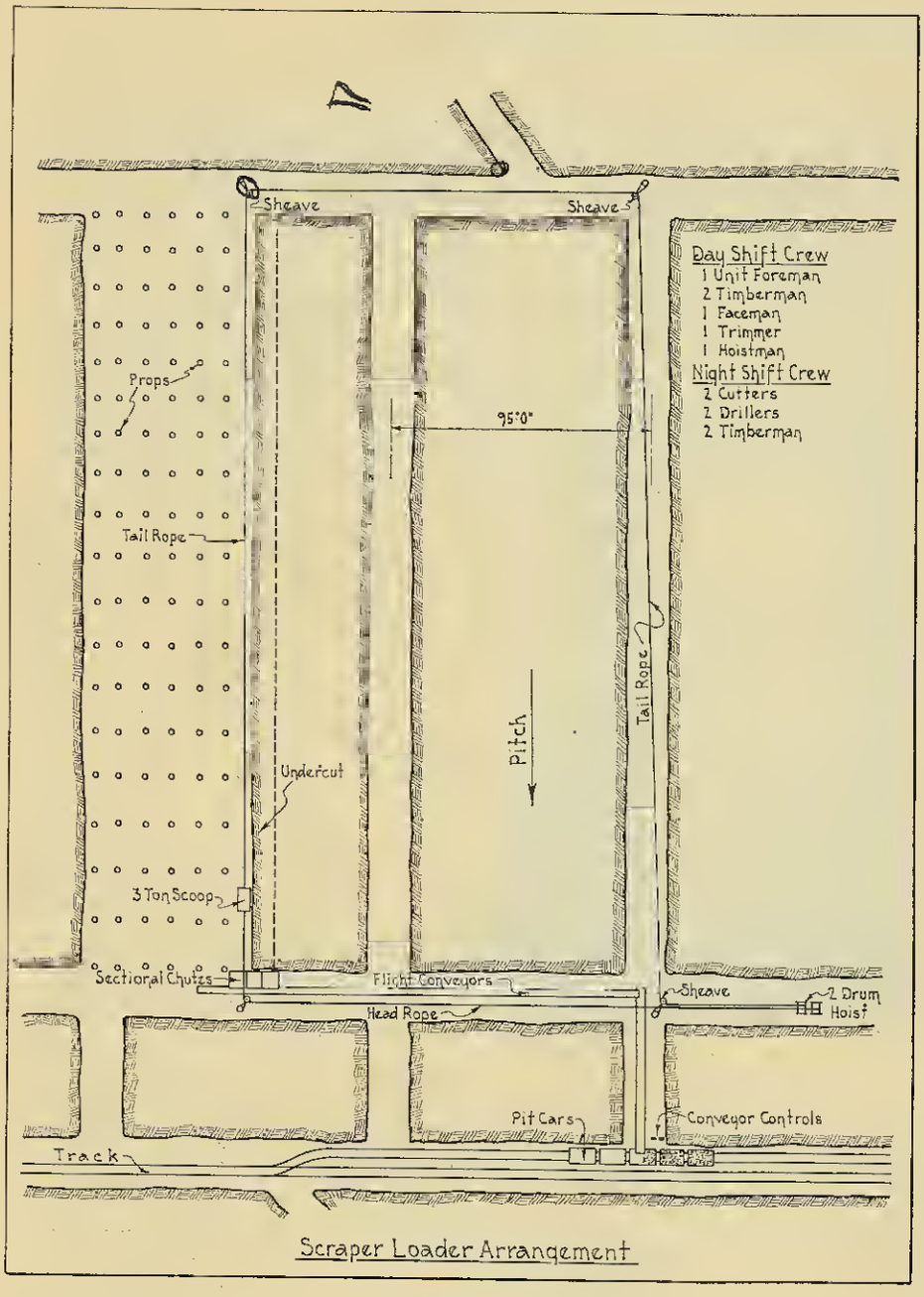


FIGURE 1

with substantial cap pieces, but where the crevices or breaks occur in the roof they are set at more frequent intervals, and in some instances cross bars are necessary. Special timbering is sometimes resorted to, a square stick of timber 8 in. x 8 in. x 8 ft. being placed with one end against the coal face, with a steel temporary prop supporting the other end. This usually keeps the roof from breaking until enough coal has been removed from the face to allow a prop to be placed under the other end without interfering with the operation of the conveyor.

In order to keep the coal from scattering when shot, to such an extent that the duckbill can not reach it, 2 in. x 12 in. x 16 ft. planks are placed on edge against the row of props nearest the face. There are 12 of these planks at each point where used, and as the face is shot down the boards are moved into position opposite the point of shooting. This means a saving of time and labor, as without the use of the planks the coal would be more or less scattered, and would have to be handled with hand shovels to a point where the duckbill could reach it.

As stated, the long face runs directly up the pitch, which is about 30 degrees off the butt. The coal would be won in larger lumps if the long face followed the butt cleat, but the size of the coal is not so important at the mines of the Union Pacific Coal Company as it is at the commercial coal operations.

When the long-face workings begin to show weight the timbermen proceed to draw the props, beginning at the upper end and working toward the lower, until all available props are removed and the roof caved. As much as 95 percent of the timber is recovered in this manner, which is remarkable in work of this kind, where the cover varies from 400 to 700 ft. in thickness. Timbers are cut the required length on the surface, and taken into the mine and delivered at the working faces as needed, thus eliminating delays to the loading units by men having to cut timber the proper lengths. Cap pieces and wedges are provided ready for use.

In the use of the shaking conveyors in the long-face work, extracting the blocks after conveyor way has been driven, the conveyor drive is placed in the lower breaking entry, and the conveyor pans are extended from the drive along the face. The coal is delivered by the conveyor pans to a flight or drag conveyor, which is installed along the breaking entry, which in turn delivers it to a short right-angle flight or drag conveyor, which delivers the coal to the pit car on the siding or passing track off the main haulage track.

In order to prevent the spillage of coal at the loading point, a sheet-iron plate is used, reaching from the rear end of the car under the loading head to the front end of the car following, so that when one car is loaded it can be moved out, and the empty car placed for loading without stopping the conveyor. The coal spilled on the sheet-iron plate is later dumped into the pit car, without blocking the track and interfering with the moving of the cars at the loading point. In order to load the pit cars to their full carrying capacity, the man at the loading head of the conveyor uses a potato fork, which is both cheap, light in weight, and convenient, and prevents injury to the hands of the man trimming the cars. Unless trimming of the cars is carefully watched, a great deal of coal is spilled along the haulage roads, and the men get into the habit of loading the cars light, which reduces the output materially, especially when the distance between the loading point and the tipple is great, as is the case in the Rock Springs mines.

To keep the conveyor pans in line, radius bars are used at points where the pans are swiveled or at any point desired. Jack posts are used as centers for the radius bars, which at one end are given a quarter turn, and formed in a ring to embrace the foot of the jack post. At a swivel one of the radius bars is put on the straight conveyor pan, and one on the opposite side of the swiveled length. Although the arcs which the

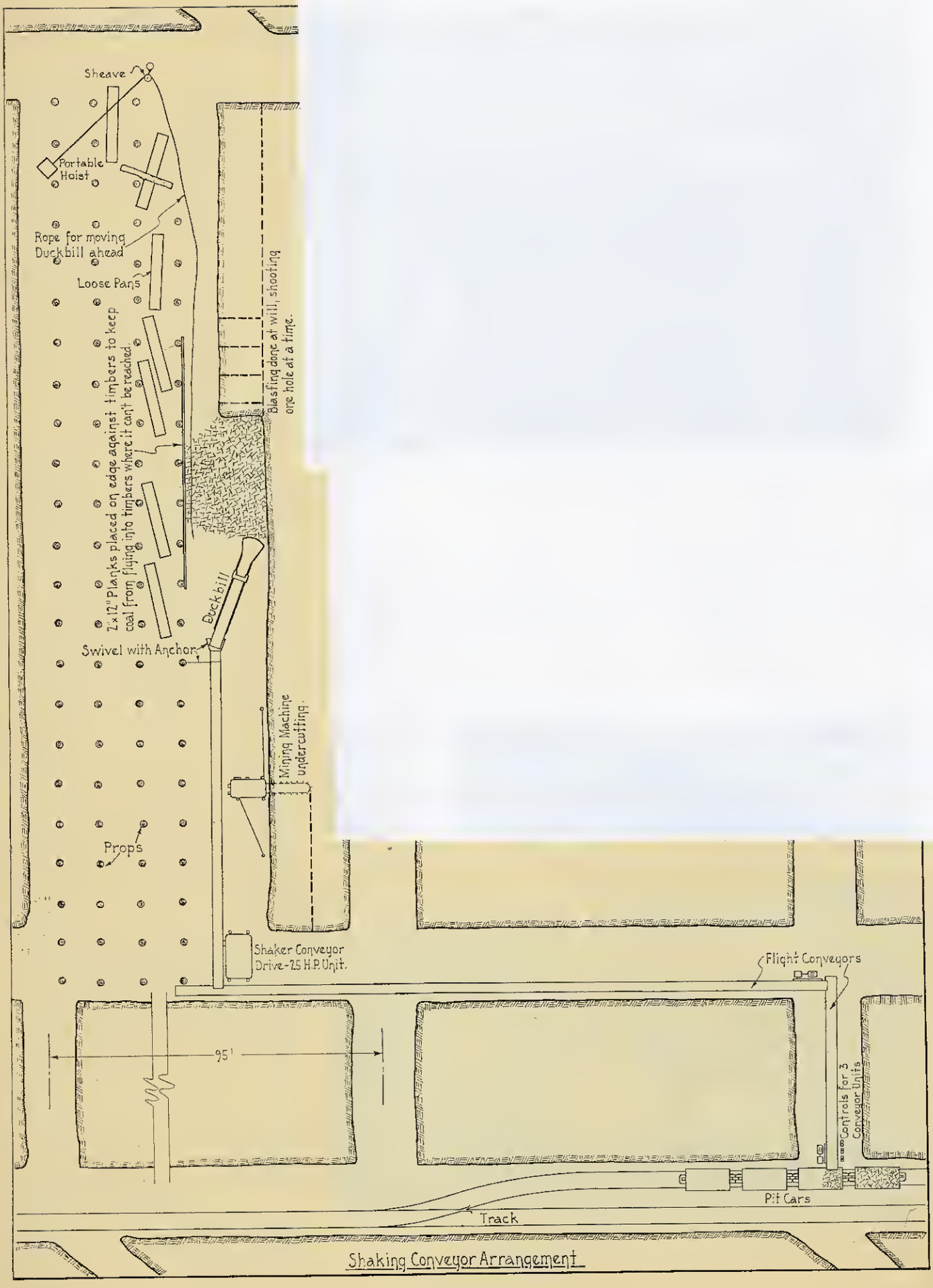

Sheave
Portable Hoist
Rope for moving Duckbill ahead
Loose Pans
2"x12" Planks placed on edge against timbers to keep coal from flying into timbers where it can't be reached.
Blasting done at will, shooting one hole at a time.
Duckbill
Swivel with Anchor
Mining Machine undercutting.
Props
Shaker Conveyor Drive-25 H.P. Unit.
Flight Conveyors
95'
Controls for 3 Conveyor Units
Pit Cars
Track
Shaking Conveyor Arrangement

FIGURE 2

Drilling long face ahead of Duckbill Loader, No. 8 Mine, Rock Springs, Wyoming.

bars travel are not parallel except at a single point, their divergence is not enough to occasion any real difficulty.

The drilling of the holes for blasting the coal is done with an electric machine supported by two men, the augur being fed by the pressure exerted by the men operating the machine. One of the prongs of the augur or drill bit is made with a square or chisel point and the other prong with a diamond point, which is arranged to lead the other prong ⅛ of an inch. This arrangement has been found to speed the cutting of the augur bit considerable, with a saving of power. The square point does the cutting, and the diamond point steers the augur. The holes are drilled to a depth of 6½ ft., leaving the back of the machine cut 12 in. in the clear.

From the year 1923 to date equipment has been added, and we have in operation at present 15 shaking conveyors, equipped with the duckbill, used in headings, conveyor ways, and the blocks by the long-face method. We are also operating one Goodman three-drum hoist unit on scraper loader, and three Vulcan double-drum hoist units, extracting the blocks on the long-face method.

In the advancement of headings with the shaking conveyors, one 25-hp. unit is used in each main and back heading. Each unit is operated by three men, who do the cutting, drilling, blasting, and loading, the unit producing on an average of 40 tons per eight-hour shift. In the driving of conveyor ways up the pitch by use of shaking conveyors, the cycle is the same as in the headings, the three men doing the cutting, drilling, blasting, and loading, and the setting of and timber necessary, the production from the unit being approximately 40 tons per eight-hour shift.

In the use of the scraper loaders on long-face work extracting the blocks after conveyor way has been driven, the hoist is placed in breaking entry a distance of approximately 150 ft. from the working place, a snubbing post to which is attached a sheave wheel being placed near loader landing station. The arrangement is shown in *Figure 1*. The main rope leads from one of the drums on the hoist, passing through the sheave wheel, and is then attached to the forward end of scraper. The tail rope, attached to the second drum, passes up the conveyor way and thence along the top breaking entry to a point in line with the working face, and down along the working face to rear end of scraper. Both the main and tail ropes are of steel construction and ⅞ in. in diameter. Along the lower breaking entry a flight

Universal Duckbill Loader working on long face, No. 8 Mine, and, below, Shaking Conveyor discharging on separate unit for loading cars

Vulcan Loader Scraper. Loading long wall face, No. 8 Mine

or drag conveyor is installed, which receives the coal from the scraper loader, which conveys it to a second flight or drag conveyor placed at right angles to the first, which deposits the coal in the cars on the haulage entry. The long face worked with the scraper loader is cut and drilled on the night shift, and is shot down during the working shift as the coal is needed. Owing to encountering bad roof in places, were the face shot down on the night shift it would have an opportunity to break during the lapse of time between the night shift and the day shift, while by shooting as needed timbering can be done immediately if necessary.

The type of equipment used in long-face work by use of scraper loaders consists of Goodman three-drum hoists, Vulcan double-drum hoists, box-shaped scrapers, Goodman undercutting machines, Van Dorn electric drilling machines, and Link-Belt drag conveyors. The number of men employed on scraper-loader units are as follows: One hoist operator, one bell ringer, one car trimmer, one unit foreman, two timbermen, the above working on the day or working shift. On the night shift six men are employed: One mining machine runner, one mining machine runner's helper, two drillers, and two timbermen, making in all a total of 12 men for the cycle. The average daily output per scraper loader is 300 tons.

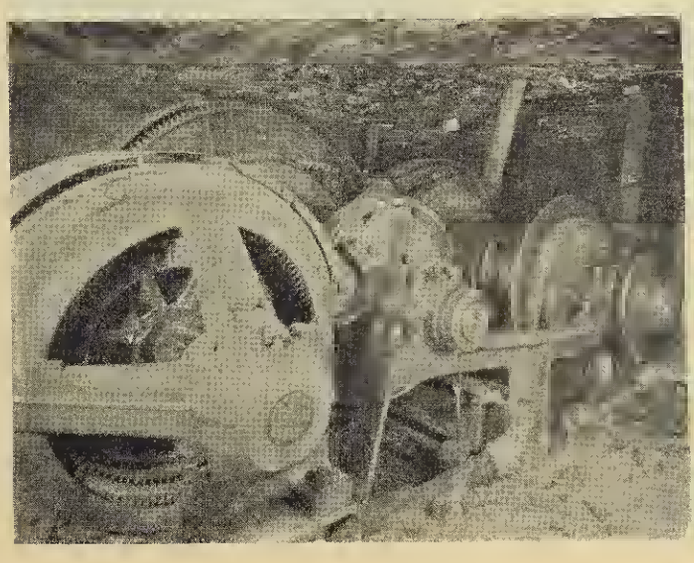
In the extraction of the blocks by the long-face method with shaking conveyors, the entire cycle is performed on the day or working shift, the mining machine cutting the lower half of the face while the conveyor is loading the upper half, and vice versa. The drilling, shooting, and timbering is all done on the working shift as needed. The number of men employed on long-face shaking conveyors being as follows: One machine runner, one machine runner's helper, one duckbill operator, one face man, two timbermen, making in all a total of six men. Average daily production from each unit, 175 tons.

The track arrangements for the storage and changing of cars in serving the shaking conveyors and scraper loaders are similar. A passing track, sometimes called a siding or parting, is provided, being of such a length that it will hold a motor trip of empty cars inby of the loading point, and a motor trip of loaded cars outby of the loading point. The cars are fed to and lowered from the loading point by means of a hemp rope attached to the side of the trip of cars and passed around a horizontal post or roller placed at a convenient point, so that the loading head man can trim and drop the cars by (*Continued on page* 37)

Top, right—Mining machine and cut on long face, No. 8 Mine.

***Lower, right**—Loading end of Vulcan Scraper Loader, No. 8 Mine.*

Below—Two drum hoist used with scraper loaders.



MECHANIZATION at WINTON

Description of seams and physical conditions—Plan of mining system—Timbering, ventilation, cutting and haulage described —100 percent mechanized loading with loading machines and duckbill conveyor—Description of entry development with mechanical loader—Description of room work with Duckbill conveyor

THE WINTON MINES of the Union Pacific Coal Company are located 12 miles north of Rock Springs, Wyo., in coal seams which are extensions of the Rock Springs field.

There are 11 known workable seams in the Winton measures, all pitching from the horizontal at an angle of 14 degrees to the west. Five seams have been developed from the outcrop. The coal is of cretaceous origin and is quite hard. The roof and floor are composed of hard slate, overlaid and underlaid with heavy sandstones. Open areas will stand for a considerable length of time before caving.

The two seams which are being worked mechanically are generally known in this field as the No. 1 seam and the No. 3 seam. The No. 1 seam ranges from 7 to 12 ft. in thickness, with a bone or rock parting varying from a streak to several feet in thickness. The No. 3 seam lies 175 ft. above No. 1, is 7½ ft. thick, and is free from partings.

Rolls frequently occur in the strata, varying the pitch of the seams as much as 5 degrees. Cover in the mines, as at present developed, ranges from 50 to 400 ft.

Slopes are driven on the pitch, and usually consist of four headings, two intakes and two returns. One intake is used as the main haulage, the other as the manway. Seventy-five ft. is the distance between parallel slope headings. Where panel slopes are used, they consist of a haulageway and a manway.

R. S. Robbins

Off the main haulage slopes, entries are driven either way at intervals of 450 ft. on a 1 percent grade favoring the loaded cars. A set consists of four parallel entries driven on 50-ft. centers, leaving a 300-ft. block between the top entry of one set and the bottom entry of the set above. (*See Plan "1."*) The first and fourth entry in the set are termed the breaking entries. The second is designated as the haulage entry, and the third as the aircourse. The haulage entry is driven 16 ft. wide to allow for double track, the other entries 12 to 14 ft. Crosscuts are driven at intervals of 250 ft. on slopes and entries, and slants 1,000 ft. apart between main and back entries.

Room and pillar workings, and also long-face workings, are developed in the 300-ft. block up the pitch. Rooms are driven from 30 to 35 ft. wide, on 60-ft. centers, off the haulage entry. Long faces are developed by driving 16-ft. rooms on 80-ft. centers, a 300-ft. face thus being provided. By this method the entire 300-ft. block is removed at the first mining, with the exception of about 10 ft. which is left as a protection for starting the next block.

Timbers of untreated native pine are set in both rooms and long faces, spaced about 4 ft. apart. Very few props or timbers are used in the entries. In long-face blocks, the props are left in place until the next adjoining block has been mined. They are then removed when the roof conditions will permit. Sometimes timber recovery is complete, but more often only partial recovery is possible. However, about 35 percent might be considered as average recovery.

The mines are ventilated by exhaust fans on the surface, which circulate considerably more air than is generally considered necessary for hand loading mines. The purpose of this is to furnish a maximum supply of fresh air to the auxiliary blowers, which are used to ventilate the working faces where the mechanical units are employed. So far, no gas has been discovered in the mine workings. However, the mines are rock-dusted according to Bureau of Mines standards, and each section isolated by the installation of standard dust barriers. In addition, all haulage entries are thoroughly sprinkled twice each week, and water sprays are placed in the intakes to supply moisture to the intake air, which is naturally light and dry. Water lines are laid to all working faces, water being used on the cutter bars of the mining machines. A water supply for this purpose is either piped in from the surface or taken from a reservoir in the mine, which is supplied by water from the slope bottoms.

All coal is undercut. Permissible powder is used exclusively. Efforts have not been concentrated on the production of a maximum percentage of lump sizes; nevertheless the amount of explosive used is restricted to the minimum required to break down the cut to sizes which can be handled without blocking the conveyors. Powder used averages 1 pound to 6 tons of coal. The final product at the tipple runs about 20 percent over a 6-in. screen, 40 percent over a 1⅝-in., and 40 percent through the latter.

Thomas Foster

By THOS. FOSTER *

K. V. CAMMACK †

F. J. STORTZ ‡

RAY ROBBINS §

Loading with 4-BU Joy Loader in slope with 15 degree dip

Haulage is one of the most important factors in the successful operation of the loading units. To insure a continuous supply of empty cars to the loading end of the units, and to provide for the concentration of several units in one heading, haulage entries are double tracked, with a cross-over switch at each loading unit, except the entry driving unit. This arrangement is shown on *Sketch "A."* The top track is used for loading, the bottom track for motor haulage. Empties are shoved or chained past the loading end and dropped into loading position by gravity. Loads are dropped out in the same manner, and are picked up by the gathering locomotive at the next lower cross-over switch. In the case of the entry driving unit, the track is extended past the loading end, along the top rib, far enough to accommodate a number of empties. Thus the lower or main track is always open for the locomotive to bring up empties and gather a full trip of loads on the way back. Main partings are provided at the slope, where the loads are delivered to the main hoist, and the empties returned. Six-ton haulage locomotives are used, and these will accommodate from four to six loading units in one entry, depending on the length of haul. Mine cars average 1½ tons each, when loaded by machines.

The methods employed in the operation of both the No. 1 mine and the No. 3 mine are the same, and the coal from each is 100 percent mechanically loaded. It will, therefore, be necessary to follow the development and operation of the No. 1 mine only. Loading in this mine is accomplished by two types of loading units, namely, the 4-BU Joy loader and the Cosco or Eickhoff conveyor equipped with duckbill. The various methods used in driving slopes, entries, crosscuts, rooms, and long faces are here described in the order in which they appeared in the course of development.

On the completion of the 1,000-ft. rock tunnel from the No. 7½ seam to the No. 1 seam in 1927, it was decided to develop and operate the No. 1 mine on a mechanical basis. The tunnel intersects the No. 1 seam about 500 ft. down the pitch from the outcrop. (*See Plan "1."*)

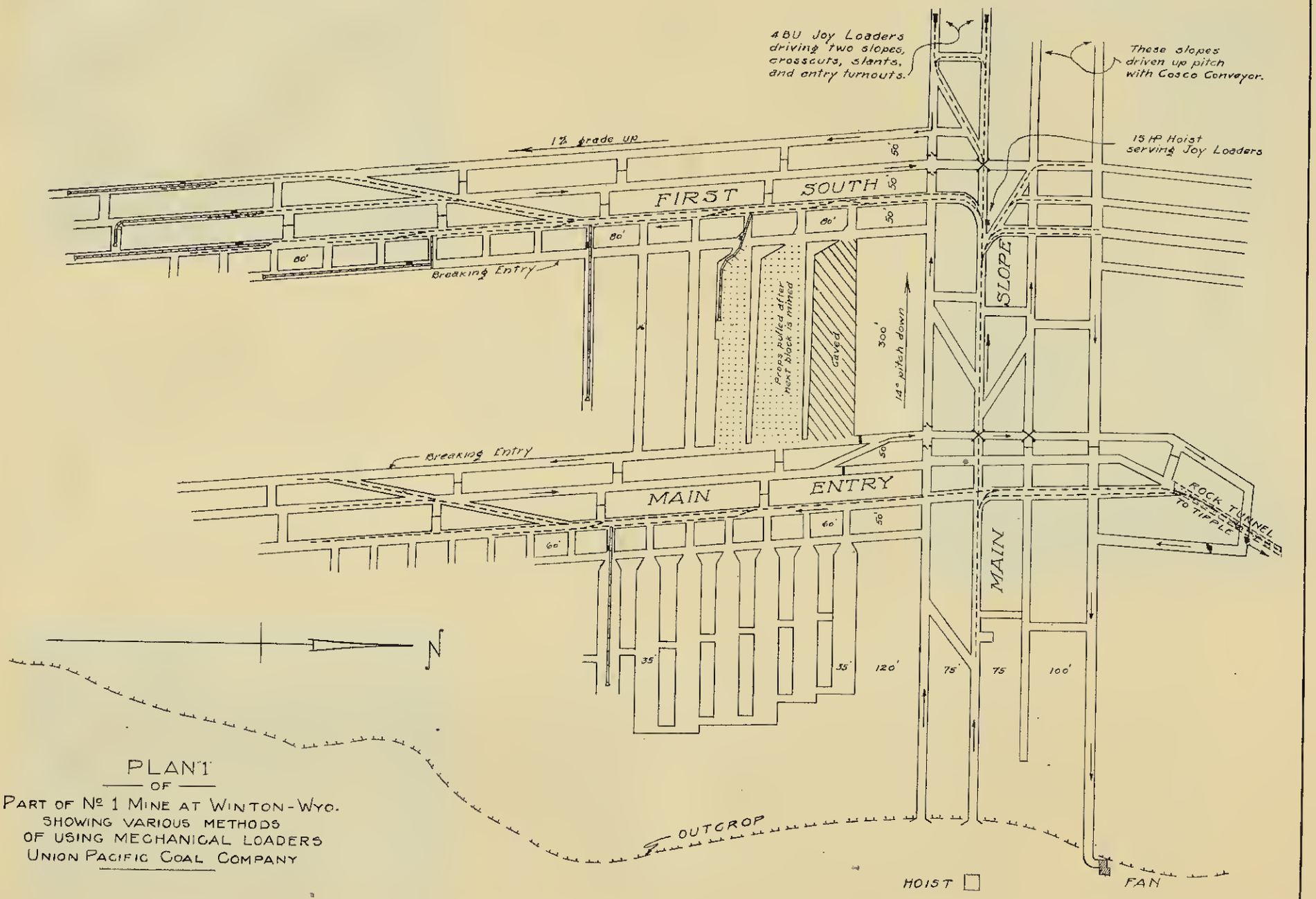
One shaker conveyor was first installed and an aircourse run from the end of the tunnel up the pitch to the crop line. Three hundred feet were driven with the first set-up, and the conveyor then moved 75 ft. along the entry and a parallel manway driven up the same distance. At this point it became necessary to drive a crosscut between these two headings for ventilation. No practical method of operating a pan line at right angles to the main conveyor was known at this time, so it was decided to try a side drive, consisting of six 12-in. sheaves, some ⅝-in. rope, and four turnbuckles. (*See Sketch "B."*) This proved to be successful, and in like operations several hundred feet of entry and crosscut were driven by this means. The only trouble encountered was in rope breakage, which was later overcome by the substitution of a rod drive instead of the rope. (*Sketch "C."*) This drive is especially adapted to four-entry development where the drive is placed in the top breaking entry, and the loading end on the haulage entry. Another method was later devised to drive places off at right angles, and is accomplished with one pan line only. This is the three-swivel set up. (*See Sketch "D."*) This is useful in turning crosscuts and room necks from entries.

After a couple of installations were made, it was realized that the prevailing

* Superintendent, The Union Pacific Coal Co.
† Mechanical Loading Supervisor, The Union Pacific Coal Co.
‡ Unit Foreman, The Union Pacific Coal Co.
§ Resident Engineer, The Union Pacific Coal Co.

Kirk V. Cammack

Fred J. Stortz



PLAN 1

OF

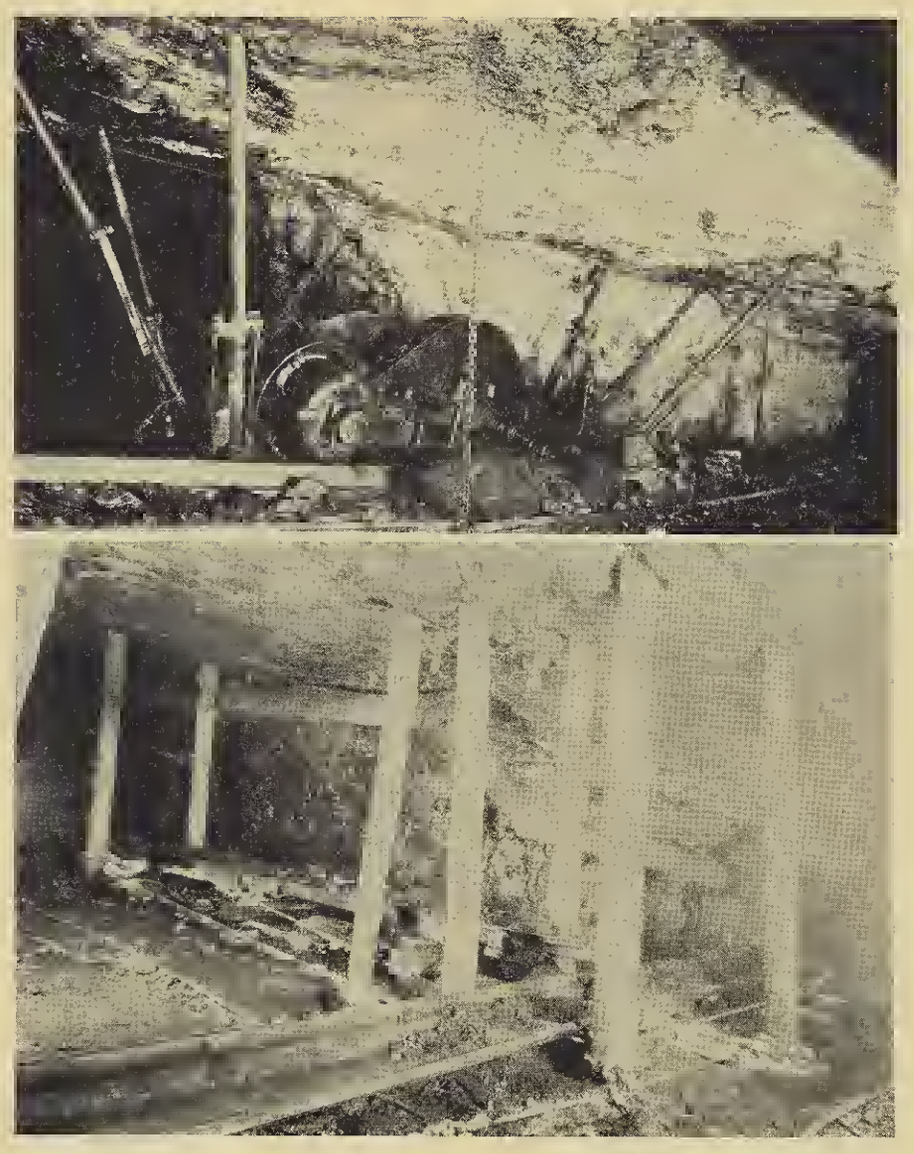
PART OF Nº 1 MINE AT WINTON-WYO.
SHOWING VARIOUS METHODS
OF USING MECHANICAL LOADERS
UNION PACIFIC COAL COMPANY

Set up of Cosco Drive with 6 Jackpipes

methods of setting up drives with props was costly and inefficient, and metal screw jacks were made to replace the props. These jacks were made of a piece of 2-in. pipe of double strength and of the desired length. The pipe is pointed at one end and a 1¾-in. hex nut welded on the other or open end. A thread bar of 1¾-in. round mild steel with standard thread, and pointed on one end, is used. Hinged handles are welded to the side of the pipe for tightening against the roof. These jacks proved amply strong for the desired use, and greatly simplified the moving and setting of the drives.

It was also realized that if some device could be made that would hold the pan line swivels firmly in place, it would be possible to turn the pan line from the direct line of drive and deflect the pan motion on an angle. For this purpose a piece of 2½ x ½-in. flat iron 4 ft. long was used. A collar was made on one end, large enough to allow a screw jack to slip through, and a hinged clevis on the other end to couple onto the connection of the swivel and pan. This combination of screw jack and stiff arm became known as a bridle jack on account of its use in guiding the pan line. When this device was connected to the swivel and the screw jack set firmly in place, it was found that it was possible to turn the pan line, as much as 30 degrees off its previous course without impairing the conveying motion. It then became apparent that the pan line might be turned to any angle merely by adding swivels and pans with accompanying stiff arms and jacks, until the desired angle had been reached. To facilitate the turning of the pan line in small areas, shorter pans, 4 to 6 ft. in length are used. If it is necessary to carry more than eight pans ahead of this swivel set-up, a heavier jack arrangement is used. This consists of a base made of ½-in. boiler plate with the corners turned down to grip the bottom, and a clevis in the top to attach the stiff arm. A screw jack is then set on each corner of the base in holes made for that purpose. This makes a very rigid set-up. It has also been demonstrated that by attaching a swivel to the drive pan, the pan line can be operated in a different direction than the entry line.

After the preliminary work from the rock tunnel had been finished, three more shaker conveyors were installed and four entries were driven to the crop line. (*Plan "1".*) Rooms were necked at 60-ft. centers on the haulage entry, and 35-ft. rooms driven up the pitch to the crop line with a shaking conveyor and duckbill attachment. The coal in this area was found to be 12 ft. in height with a boney parting 5½ ft. below the roof. At first an attempt was made to take the entire 12 ft. on the advance up the pitch. This, however, proved to be dangerous practice as the face had a tendency to fall away from the roof when undercut. It was then decided to mine the bottom coal up to the parting until the room was finished and then take the top coal on the retreat. This proved satisfactory and this method has since been used in all high coal.

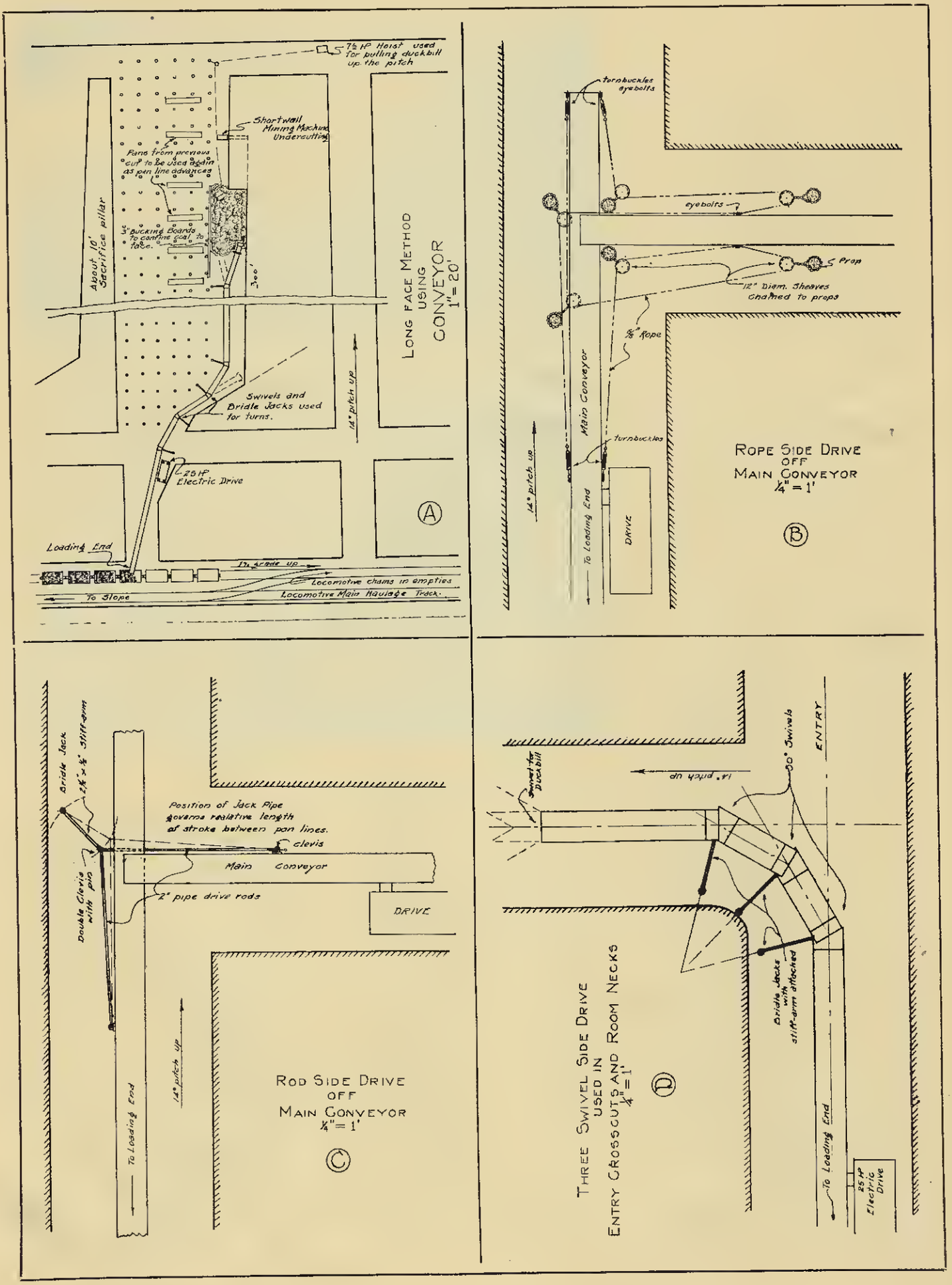


Shaker Conveyor with right angle rope drive

While the first set of entries was under development, slopes were started down the pitch to open up additional territory. A flight conveyor was first tried in the slope, and then a shovel loader. Owing to the pitch of the seam neither proved successful. An old 4-BU Joy loader was then secured, and gave satisfactory results in the slope work. As soon as the usefulness of this machine had been proven, another was placed in the back slope and a small D. C. sinking hoist set to serve them. A crew of five men was placed on each shift. Each crew consisted of a Joy operator, roperider, hoistman, machine man and machine helper.

The face cycle of operation is as follows. The Joy is first placed in the center of the slope and worked down to the face. The hoist rope is then attached to the Joy to assist in pulling it out of the face and shifting it over to the right side of the slope. Here, it is again worked down to the face, pulled back and shifted to the left side, which is cleaned up last. Such slack coal as is not picked up by the Joy, is shoveled onto the machine by the operator and rope runner, and the Joy is then pulled back along the left hand rib to clear the face for cutting. While the loading process is on, the rock or bone in the coal is picked off the conveyor by the operator and helper and gobbed along the rib.

As soon as the loading has been completed, the operator moves over to the other slope, where a fall of coal is ready to be loaded by the other Joy. The same process is repeated here. The machine man and his helper follow in the slope


7½ HP Hoist used for pulling duckbill up the pitch
Shortwall Mining Machine Undercutting
Pans from previous cut to be used again as pan line advances
3" Bucking Boards to confine coal to face.
About 10' Sacrifice pillar
300'
Swivels and Bridle Jacks used for turns.
14° pitch up
25 HP Electric Drive
Loading End
1% grade up
Locomotive chains in empties
To Slope
Locomotive Main Haulage Track.
LONG FACE METHOD USING CONVEYOR 1"=20'
Ⓐ
turnbuckles eyebolts
eyebolts
Prop
12" Diam. Sheaves chained to props
⅝" Rope
Main Conveyor
turnbuckles
14° pitch up
To Loading End
DRIVE
ROPE SIDE DRIVE OFF MAIN CONVEYOR ¼"=1'
Ⓑ
Bridle Jack 2¼"x¾" Stiff-arm
Position of Jack Pipe governs relative length of stroke between pan lines.
clevis
Main Conveyor
Double Clevis with pin
2" pipe drive rods
DRIVE
14° pitch up
To Loading End
ROD SIDE DRIVE OFF MAIN CONVEYOR ¼"=1'
Ⓒ
Swivel for Duckbill
12° pitch up
30° Swivels
ENTRY
Bridle Jacks with stiff-arm attached
To Loading End
25 HP Electric Drive
THREE SWIVEL SIDE DRIVE USED IN ENTRY CROSSCUTS AND ROOM NECKS ¼"=1'
Ⓓ

VENTILATION

By HUGH MCLEOD *

ance, which passes 150,000 cu. ft. per minute with a 1.4-in. water gauge.

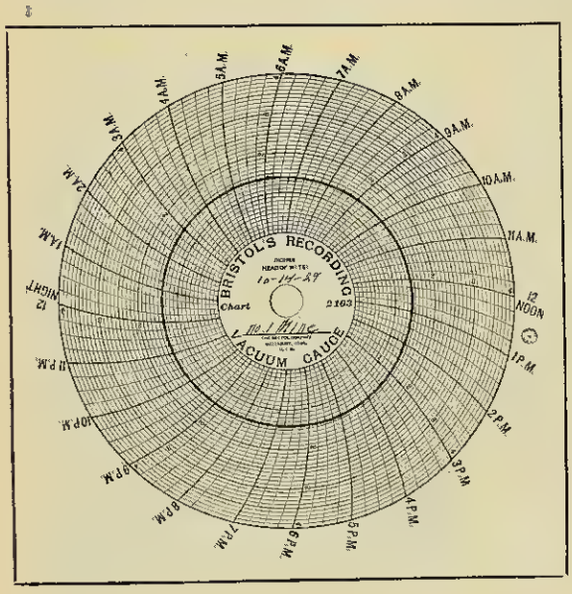
The practice of splitting the air is followed throughout all of the Union Pacific mines, each entry or section being upon a split of its own, wherever possible. Company rules specify that "at each split not less than 65 percent of the air entering any split shall pass through the last crosscut. This amount, 65 percent, to be in excess of the law's requirements." Where roof conditions are such that little or no weight is thrown upon the stoppings, tile is used in their construction. While cost of tile stoppings is less than that of any other type of stopping of fireproof construction, however, it is unsatisfactory where the tile are subjected to roof pressure. Rock and concrete stoppings are used wherever the tile stoppings are inapplicable; however, they are more expensive, but, viewed from all angles, the latter are most satisfactory.

In areas of fire within the mines neither tile, concrete nor rock stoppings are used. As a rule, these fire areas are subjected to considerable roof movement and any stopping so resistant as a masonry wall can not be kept tight at the rib. For this reason, block stoppings laid up in clay and faced with plaster are used exclusively for sealing fires. All of the fire stoppings are equipped with 2-in. pipes with a gate valve in each pipe, the use of a gate valve on these pipes making it possible to insert a thermometer for taking temperatures, also facilitating the taking of samples from behind the seal. These samples are taken at regular intervals and are analyzed with the Orsat testing equipment.

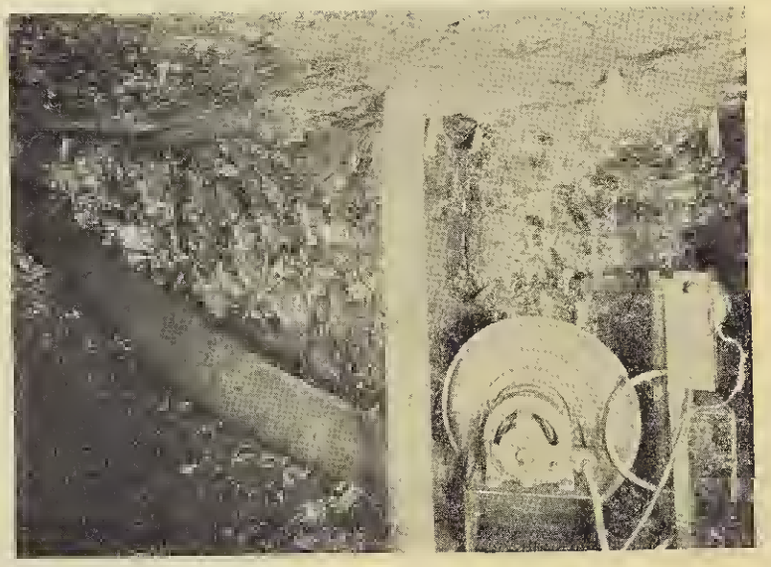
Overcasts are all of fireproof construction using either concrete, tile, or masonry sidewalls, the span of the overcast supported by steel rails, which are cemented in place, using tile for the floor. Easement for the air at overcast is provided by banking the ends. As before stated, the area above overcasts on main returns is equal to the average cross section of the air course. In the construction of overcasts, care is taken to avoid sharp bends in constricted areas as much as possible in an attempt to reduce frictional resistance to a minimum.

One important regulation pertaining to fan charts is, "The fan chart must be changed daily before 7.30 a. m. and it shall be examined by the mine foreman who shall satisfy himself that the fan has been in continuous operation for not less than six hours preceding his examination of the chart, signing his name thereon, prior to permission being given any working force to enter the mine" (Sec. 4435, Mining Laws of Wyoming). "Fan charts shall bear the date of their placement on recording instrument, and breaks in graph, whether showing complete stoppage of fan or changes in water gauge, must be explained in detail on back of charts. The mine foreman will make prompt delivery of fan charts to the mine superintendent, who will examine and thereafter countersign same, forwarding all charts to the general office on the same day they are removed from the recording instrument". This regulation has done much to assure nearly 100 percent operation of mine fans, as all operating officials are thus kept in daily touch with fan operation and are particularly desirous that no stoppage be recorded from avoidable cause.

The loading of coal by mechanical means has brought about a new condition within the mines necessitating changes in many ways. With immobile types of loading equipment, such as the shaking conveyor, it is imperative that shots be fired on the working shift. That this may be done (in nongaseous mines) it is essential that large volumes of air be delivered directly at the working face. To accomplish this (*Continued on page* 53)



Typical fan chart from No. 1 Mine, Reliance



Typical booster fan installation, No. 8 Mine, Rock Springs. The surrounding canvas has been taken down to obtain the photograph

HANDLING EXPLOSIVES

Upper, left: Cap man taking caps from cap house to mine

Left: Main storage magazine for permissibles

Below: Powder house inside of mine

Above: Main cap storage magazine

Left, below: Making cartridges of explosive at mine magazine

Right, below: Charging drill holes. Note paper bags filled with clay and wooden tamping bar

at Reliance

By M. W. MEDILL *

Powder magazines and methods of distribution — All permissible explosive with electric firing — Containers and powder cars—Methods of shot firing—Safety precautions followed

THE handling of explosives requires constant care and supervision in order that the maximum efficiency may be obtained and the number of accidents be reduced to a minimum. Blasting of coal in the Reliance mines is done with permissible explosives and electric detonators of No. 6 strength. These permissibles are susceptible to moisture, and if care is not taken in storage their efficiency may be impaired.

All explosives are ordered through the store department. As soon as a carload of permissible is received in the railroad yard it is transferred by wagon to the main magazine, care being taken that the wooden cases are not broken in the handling. The fresh shipment is stacked separately from cases already in storage so that the older supply may become exhausted before any of later date is removed.

The main magazine, situated the required distance from any habitation, has a storage capacity of more than one carload and is of concrete and rock construction with provision for adequate drainage and ventilation. Each day the store department transfers the required amount of explosive from this magazine to the one at the mine.

The permissibles are handled in fiber boxes from the mine magazine to the working face. At the end of each shift the miners leave one of their empty containers in a large box at the mouth of the mine. The next morning these containers are taken from the mine mouth to the mine magazine to be filled.

Before the cartridges are placed in the fiber boxes they are marked individually, by means of a special stamp, with the check number of the miner or loading unit to which they are consigned. The stamps perforate the paper shells and there is little chance that the markings may be erased. If any sticks of explosive should be found amongst the coal in the pit cars, on the screens or chutes at the tipple, or in the railroad cars, it is an easy matter to ascertain the miner or unit crew that was negligent in the handling of the explosive, and steps can then be taken to prevent repetition of the offense.

The filled containers are taken from the mine magazine and placed in a specially constructed powder car, having hinged doors covering the top, and an insulated drawbar. After the day shift has left, the powder car is lowered into the mine with the slope rope, and the containers are stored in the inside powder house until morning.

A man, detailed for the duty, precedes the day shift into the mine. He arranges the containers in numerical order and as the miners pass the powder house they call their check number, and the desired container is passed to them. The miner carries the filled container to his working station where he places it in a covered wooden box, situated in a crosscut or a recess in the rib away from possible haulage accidents or falls of rock or coal.

Before the charges are made up and the drill holes tamped, all power is cut off wires leading into the working place as a safety precaution against premature explosions. The charges consist of not more than 1½ lbs. of permissible explosive with electric detonator having 8-ft. lead wires. In charging the drill holes, it is essential that all sticks of explosive be pushed together to the back of the hole to prevent a parting of coal dust forming between the several cartridges, resulting in unexploded powder being left at the back of the hole when the charge is detonated. After the explosives have been inserted, the balance of the drill hole is tamped to the collar with incombustible material, usually clay, contained in paper bags 1½ in. x 11 in.

During the night shift a certified shot firer visits the working faces, and, after examining the shots, he finds that all holes are tamped to the collar and none are drilled on the solid, he connects the shots singly to a No. 18 rubber-covered cable and detonates the charge with a permissible shot-firing machine of the magneto type.

The electric detonators are handled through the store department in the same manner as the permissible explosives. They are hauled from the railroad car to the main cap magazine, and from there each day's requirements are taken to the mine cap house. A cap man takes a day's supply of detonators from the mine cap house and visits all working places, leaving the desired number of caps with the miner or loading unit crew. If there should be any caps remaining after making the round of the mine he places them in a concrete box provided for cap storage.

SAFETY PRECAUTIONS

Careful handling of explosives during transfer from railroad car to storage magazine.

Storage in a well-drained and ventilated magazine.

Only permissible explosives are used in the blasting operations.

Marking each cartridge with the miner's or unit's check number. This tends to make the workman more careful in the handling of the explosive.

Explosives kept in locked magazines.

Explosives taken into the mine in properly insulated powder cars.

Explosives carried in fiber containers.

A responsible man to issue filled containers and keep an accurate list of all boxes handled.

A responsible man to deliver caps and keep a check of same.

Detonators, with ends twisted together, kept in cardboard containers until needed.

All power cut off wires leading into working places before charging drill holes.

Charges for drill holes kept within the permissible limit.

The use of a wooden bar in tamping drill holes. All holes to be stemmed to the collar.

Shots fired by certified shot firers after the day shift has left the mine.

Shots fired with a well-insulated cable and permissible blasting machine.

* Superintendent, Reliance Mines, The Union Pacific Coal Company.

SAFETY

Trip of loaded mine cars receiving spray of water as it leaves the partings on its way to the outside

TO PROCURE the maximum of safety in coal-mining operations of the Union Pacific Coal Company five cardinal principles are recognized, viz:

(1) Adequate and uninterrupted ventilation.

(2) The use of only permissible powders.

(3) Elimination of open lights.

(4) Reduction of coal dust and the prevention of dust dissemination through the workings.

(5) A trained and disciplined personnel constantly cognizant of their individual responsibility.

Of these the last is by far the greatest and most important, and, apparently, the hardest to secure. Merely by money expenditures the first four can be obtained, but expenditures, no matter how great, can not buy the last, unless each and every workman is willing to give his unrestricted cooperation and wholehearted support to the safety movement.

It is probably true that our present civilization has been made possible only by the fact that a few of the more daring ones have always been willing to "take a chance," and, as this characteristic will always be a predominating one, it is unlikely that a point will ever be reached in coal mining where there are no accidents. To bring accidents to an irreducible minimum and the elimination of the avoidable injuries is the aim of this company.

The Union Pacific Coal Company was one of the first coal-producing concerns in the United States to recognize the possibilities of an inert dust as a preventive against explosion propagation and to start practical experimenting along this line.

As early as the summer of 1911, adobe dust was introduced into No. 1 mine, Reliance; it then applied to haulageways and manways, the idea being that the travel by men and animals would keep the dust in suspension to be carried by the ventilating currents and later be deposited on roof, sides, and timbers. Meeting with objections on account of the possible physical effect of the dust upon employes, the experiment was abandoned and no further work was done with rock dust until 1924, when an active program was inaugurated.

With but little known as to methods, representatives were sent to various companies who at that time had assumed leadership in rock-dusting experiments, and the results of their efforts were brought back and adopted. As a consequence, the Union Pacific Coal Company was among the earliest coal producers in the United States to boast of 100 percent rock-dusted mines.

As it was impossible at that time in this district to purchase a satisfactory material for rock-dusting purposes, the dust was originally manufactured on the property. A fire, two years ago, destroyed the plant, which by then was obsolete and inefficient, so since that time the dust has been purchased from cement plants. An average of 2,500 tons of dust are required annually in the 11 mines of the company.

All entries, slopes, haulageways, and portions of the mines which are readily accessible are dusted on roof and ribs. Both machine and hand casting methods are used, the manner of application being largely governed by the physical properties of the places that are to be treated, and, to a lesser extent, by the preference of the local superintendent.

Trackless and remote portions of the

* Safety Engineer, The Union Pacific Coal Company.

Sprinkling pipe and stand used for wetting empty cars before they are taken into the mine. This precaution has proven helpful in the prevention of dust dissemination in the mines

A rock-dusting machine at No. 1 Mine, Reliance, Wyo.

DEPARTMENT

By J. A. SMITH *

Rock dusting and dust barriers—Sprinkling system for loaded trips, haulageways — Atomizers on intake air—Water for machine cutter bar—Closed lights—Mine rescue, fire fighting and first aid training

mines are protected with dust barriers of the V trough, 16 troughs per battery, type which are located at strategic points. In addition to the dusting of the entries, all haulageways are equipped with dust barriers, thus sectionalizing the mine and constituting a secondary defense.

In order that operating officials will at no time feel a false sense of security from the rock dust, at regular intervals dust samples are collected from all mines and analyses are made for incombustible content. These analyses are made with an M-S-A volumeter. Whenever it is shown that parts of the mine are running too high in combustible content, these portions are immediately redusted.

With a view to further elimination of explosion hazard, after much preliminary experimenting black powder was eliminated from all mines of the system, and for the past several years nothing but a powder bearing the permissible stamp is permitted within the mines. As a further precaution, systems have been developed in the handling of powder, both underground and surface, until today it is felt that the possibility of accident from powder and from blasting practices has been reduced to a minimum. This is reflected in the accident record, which shows remarkably few injuries considering the amount of powder used, blasting done, and the varying conditions under which the coal is mined.

A fundamental principle in the battle against coal dust is the allaying of it at its source, thereby preventing its presence in the ventilating currents to be carried and deposited in all portions of the mine. During 1925 and 1926 approximately 60 miles of pipe lines were laid in order that all mines could be adequately equipped with sprinkling systems. This included pipe lines into every working face in order that water could be applied on cutter-bars of mining machines; sprinkling devices for wetting down the tops of loaded cars as they leave the partings and the empty cars as they enter the mine; in certain cases atomizers on intake air; and pipe lines with hose connections for sprinkling haulageways and traveling entries.

In all mines of the system water on the cutter-bars of mining machines is today considered as indispensable as the electric power, and any employe found violating this rule is subjected to discipline, and, in aggravated cases, to discharge. After machine men have once realized the value of water and have experienced the decreased inconveniences of their tasks, due to the freedom from coal dust in the air they must breathe, no opposition is met in its use, and the men would, under no circumstances, return to the old dry cutting methods. Incidentally, it might be mentioned that the Union Pacific Coal Company was among the first, if not the first, in the United States to use water on cutter-bars of mining machines. It was first used in No. 4 mine at Hanna, Wyo., in 1912, and has been practically in constant use at that place since that date. The use gradually spread to the other mines, and became universal in 1926.

The sprinkling of loaded and empty cars has proven to be another beneficial step in the prevention of dust dissemination. In addition to the wetting of the coal at the face before loading, the tops of the loaded cars receive a spray of water as they leave for the tipple, and again the empty cars are wetted before being returned to the mine. The effect is particularly noticeable on the entry ribs and on the timbers in places where the trip movement is rapid. Here it is found that the dust deposit is greatly reduced and can be readily neutralized by the application of rock dust.

With the exception of the three mines in the Hanna and Cumberland districts, all Union Pacific mines are nongassy.

First aid teams at work during the annual contest at Rock Springs. Thirty-one teams, including Boy and Girl Scout teams, took part in the 1929 competition

Interior of lamp house at Rock Springs. This place has a capacity of 1,000 lamps, each employe receiving his lamp in the morning and returning it at the completion of the shift

V-trough dust barriers. Sixteen troughs, each containing 300 pounds of shale dust, constitute a battery. These troughs are set in ¾-in. notches and are easily tipped, discharging their contents into the atmosphere, in case of explosion

Men working at faces of stopes and panels are protected from possible run-away cars by heavy rails, suspended from timbers and resting between the rails

Nevertheless, all are worked on the same basis as though they were producing gas. All open lights are prohibited, each miner being supplied daily with an approved electric cap lamp. A daily charge covering the cost of charging, repairs, and maintenance is made to each employe for these lamps, no attempt being made by the company to make this charge a source of revenue. While some opposition was met from a few employes when electric cap lamps were installed, it is very doubtful if any would return to the old carbide lamp as the increased illumination, steady light, and the absence of disagreeable odors more than compensate for the increased weight carried.

Much work has been done toward training the employes in first aid. This training has always been voluntary on the part of the men, and to date approximately 70 percent of the men on the pay rolls are holders of first-aid certificates. This training is given under the direction of representatives of the United States Bureau of Mines. At each of the districts first-aid and mine-rescue stations are maintained and selected groups of men are constantly kept in training to cope with any emergency that might arise. All stations are equipped with five sets of self-contained oxygen breathing apparatus, gas masks of the two-hour and half-hour types, first-aid material, and all other equipment that might be immediately necessary in case of disaster.

Annually a first-aid meet is held at Rock Springs, at which time all districts are represented by one or more first-aid teams, in addition to several teams of Boy and Girl Scouts. Prior to the past two years, a mine-rescue contest was held at this time, but, owing to the increased number of participating teams, limited time available, and the scarcity of competent judges, the mine-rescue events have been eliminated and the contest confined to first-aid events. In addition to the laurel wreath of victory, the team winners are awarded individual prizes.

Much stress is placed upon fire and fire-fighting equipment. While the elimination of the fire hazard is considered the fundamental principle, in case of underground fire reliance is placed upon the water lines and hose, rock dust placed at points of possible origin, and abundant fire extinguishers of the soda-acid and tetrachloride types. Underground stables, where the fire hazard is always greatest, in addition to the usual water and extinguishers, are equipped with automatic sprinkling systems. All fire-fighting equipment is tested at least semiannually, and defective parts replaced. At the Reliance mine and Hanna No. 2 mine, large areas have fired, and, as the physical properties preclude the possibility of contact fighting, these areas are sealed. Seals are examined every eight hours and record made of the examination.

Much of the accident-prevention work of the company has been along the lines of elimination of the various individual hazards, in ways too numerous to mention in a short article. Two precautions that have been especially productive in results are the provisions for clearance in the mines and the inspection of all electrical and mechanical installations before they are allowed to be used. Following two fatal accidents in the mines, both due to insufficient clearance between the cars and the entry rib, an active campaign was inaugurated to provide 30 in. clearance between the track and ribs. At considerable expense, this was accomplished, and now, with inflexible rules governing setting of timbers, laying of track, and unloading material within the 30-in. clearance distance, during the past three years there have been no serious accidents attributable to this cause.

Before any mechanical or electrical installation can be operated it must be inspected. When installation is commenced a red "danger" tag is placed upon the controller, indicating that before it can be started that the red tag must be removed. Upon the completion of the work, the chief electrician and the safety engineer must make an inspection, and they are the only ones empowered to remove the red tag. It has been found that, not only for safety but from a standpoint of first-class workmanship, much benefit results. It is only natural that if a workman knows that his work will be inspected and passed upon that he will put forth his best efforts, and the minor details, so often slighted, will receive the necessary attention.

With the exception of the few things that the operator can do toward safety, most of which can be expressed in terms of money expenditures, in the last analysis, the safety movement is an individual affair. Nothing that the operator can purchase can make a man think. For this reason, the discipline of the individual and the discipline of the general organization is the only means by which the accident rate in coal mining can be reduced. Competent authorities estimate that 95 percent of all accidents are avoidable. Of these, probably 90 percent are caused by acts of omission or commission on the part of the ones injured. To bring this situation squarely before the workman and cause him to think safely and act safely is the great problem of the industry.

The company maintains a book of safety standards, printed in loose-leaf form, which is revised from time to time as experience suggests. This book is for the use and guidance of all officials of the operating (*Continued on page* 53)

TIME STUDIES

By R. R. KNILL *

Time studies on mechanized loading—Man-minute and machine-minute bases—Operating divisions of the loading cycle—Charts for different types of studies

THE success or failure of a mechanical loading program depends upon the efficiency of the individual working units and the coordination between them. To obtain this, it is essential to have definite data concerning the capacities of the haulage equipment, tipples, and the loading machines. Getting this information calls for the "time study."

Time studies taken by this company are mostly graphical and are usually taken on a man-minute or a machine-minute basis. At times it becomes necessary to use a combination of the two. Some haulage studies are taken by recording time, work performed, and location in a notebook, but unless this is made into a graph they are not as comprehensive as they should be.

The graph is made in pencil in the field as the work is performed and inked in the office, so that blue prints can be made for the use of the underground management. The different pieces of work done are recorded on the left side of the paper, and usually 10 lines are allowed to show the work for each hour. There is enough room to show one-half shift on each page. The paper is divided into 60 spaces from left to right, and each space represents one minute, so that each section shows one hour of time across the paper.

The taking of time studies is best explained by referring to the graphs. *Figure 1*, which is a study of a 5-BU Joy loader, is taken on a machine-minute basis. Such notes can be taken either upon the graph or a separate piece of paper and as much information as possible concerning the conditions of the working place, haulage, supervision, members of the crew, material, etc., should be recorded. The first section shows the time from 7 to 8 o'clock. The graph starts at 7.30 and shows five spaces or five minutes "starting" which is the time of the shift used by the men to take off coats, get a drink, etc. At 7.35 a vertical line is made from item "starting" to "loading," indicating time loading started. Loading was easy, and the first car was loaded in one minute. There was no delay changing cars and loading continued for one minute longer; the line drops to "picking"; the machine was delayed two minutes while the face was loosened by picking. Loading continued for one-half minute and it was necessary to shift the machine, and so on. The horizontal lines indicate time and the vertical lines a change of work. As each car is loaded a small vertical line is made with a number above it, showing the number of cars loaded thus far. The total for each item during the hour is obtained by adding the spaces across which were used by the graph line. The result of the first half hour's work shows: "Starting," 5 minutes; "loading," 13 minutes; "shifting conveyor," one-half minute; "shifting machine," 4½ minutes; "shifting cars," one-half minute; and "picking," 6½ minutes, making a total of 30 minutes. The hourly totals are added to get the total for each item for the day.

The man-minute study is taken very similarly. *Figure 2* shows a study taken on the man-minute basis. This graph is made of a shaking conveyor working in a scraper pillar. There are four men to the crew; one at the discharge end of the pass and three at the face. This study is made with the time study engineer at the face so that the cars are not noted as loaded. although it is usually possible to do this. The number of cars loaded can be obtained from the man at the discharge end hourly or at the end of the shift. The man-minute study considers the men of the crew and not the machine. The same graph is used as for the other and the time is marked off similarly. The numbers shown on the graph at the vertical lines indicate the number of men performing that particular piece of work. "Loading" on this graph represents the time spent by the car loader at the discharge end and also the time the conveyor is running. The graph starts at 7.30, and five minutes is used "starting"; at 7.35 one man is charged to "drilling" and three to "fixing rollers"; 7.39 two men were "drilling" and two men "fixing rollers," and so forth. To calculate the number of man-minutes, multiply the number of spaces by the figure at the vertical line. Calculating the man-minutes for the first half hour there would be: "Starting," 5 spaces or minutes by 4, making 20 man-minutes; "loading," none; "drilling," 1 times 4, plus 2 times 13, totaling 30; "fixing rollers," 3 times 4, plus 2 times 21, totaling 54; "miscellaneous," 2 times 8, equaling 16. The total for the five items is 120 man-minutes, which is equivalent to four men working 30 minutes each. The total for the day is made from the hourly sections calculated as above.

The four time studies shown were chosen to show the different applications. *Figures 1 and 2* were described above. *Figure 3* is a study of the shaking conveyor on the long face and is machine-minute study except the dotted lines on the graph, which are man-minutes and represent the time spent by extra men to handle rock. *Figure 4* shows the movements of three pit-car loaders and the motorman serving them. The first five lines of each hour shows the loaders, and the second five the motorman, who also snubs some of the cars into the rooms. The lines opposite "Nos. 1, 2, and 3 Loading" represent the time each one was loading. The time spent by each machine waiting on cars is shown on the line "Waiting on cars" by the space from the vertical line dropping from the "loading" line to the vertical line returning to the "loading" line; that is to say, No. 2 machine waited from 8.19 to 8.33. The graph below shows what the haulage man was doing during that period.

The reports on the time studies consist of a blue print of the graph, general dis-

* Mechanical Foreman, The Union Pacific Coal Company.

Fig.1 Time Study of Joy Loader

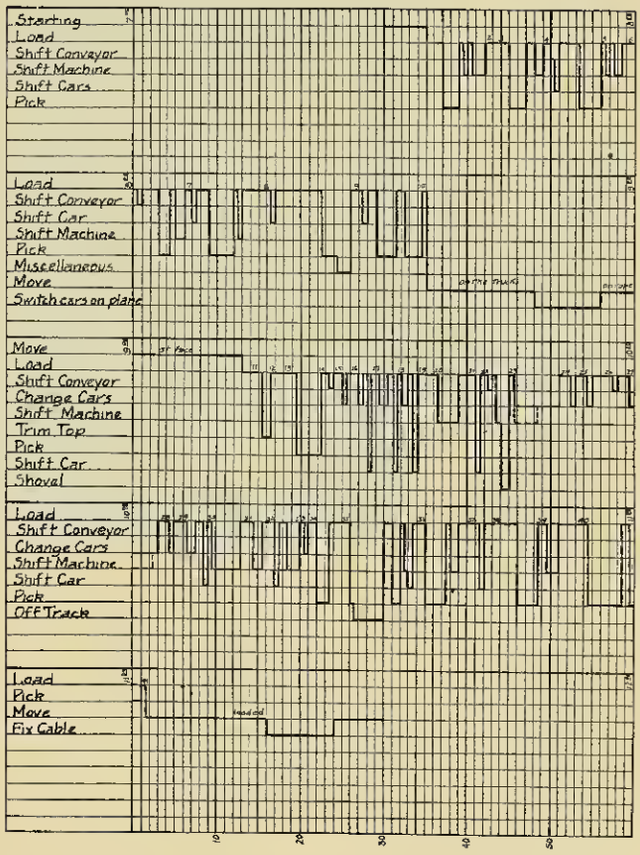


Fig 2 Man Minute Study of Shaking Conveyor

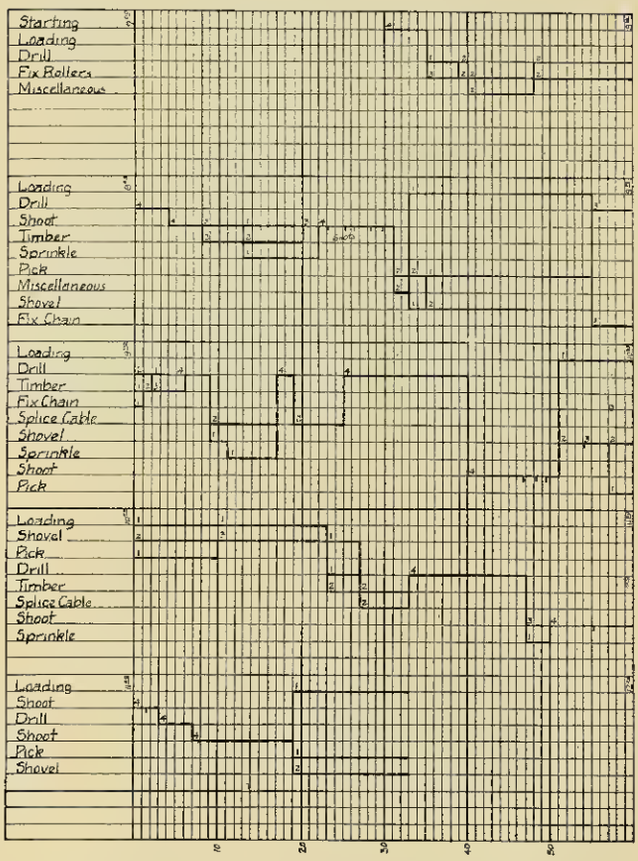


Fig 3 Time Study of Shaking Conveyor on Long Face

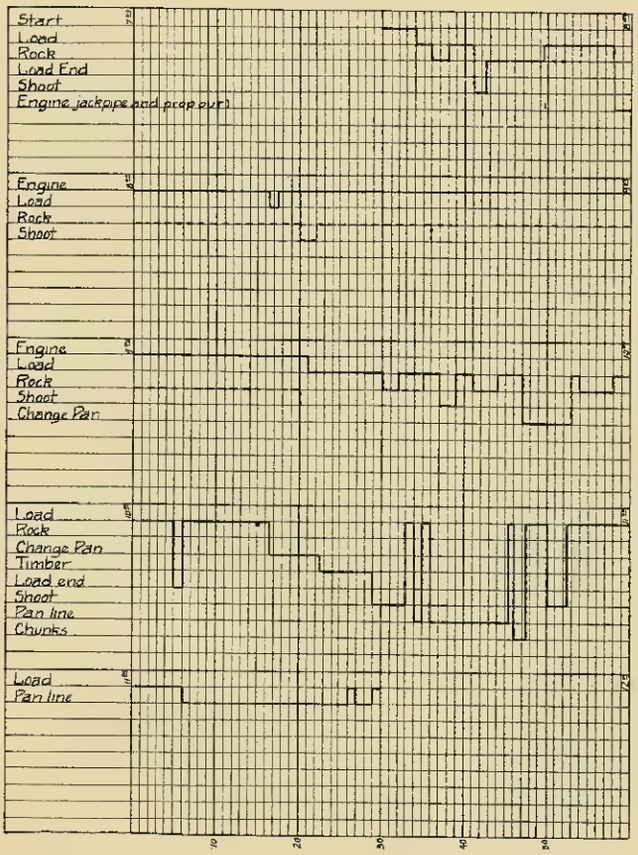
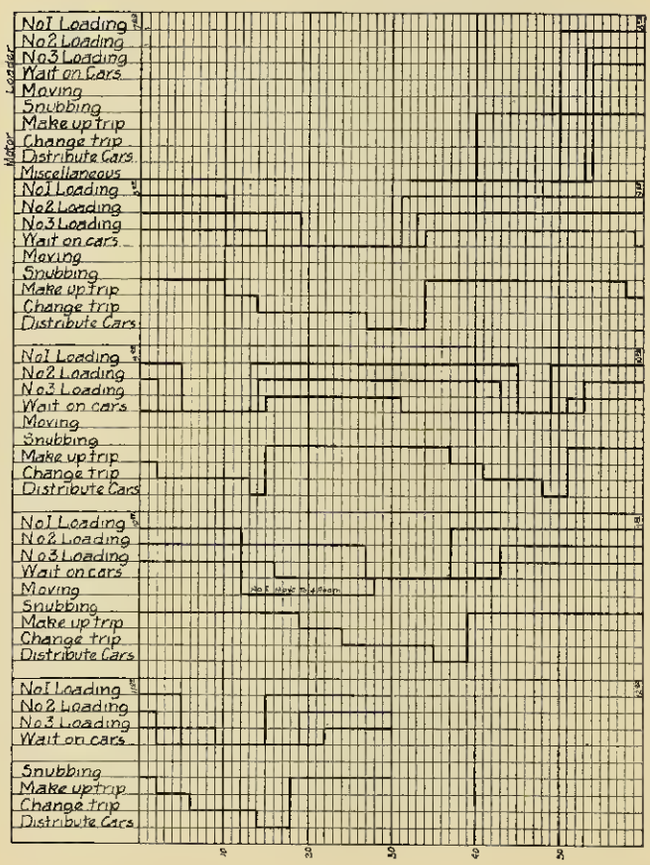


Fig.4 Time Study of Pit Car Loaders and Haulage Motor



cussion of the day's work when the first study is reported, and a summary similar to the one shown below:

SUMMARY

Item	Machine Minutes	Percen.	Remarks.
Start	4	.83	
Loading	202	42.09	182 tons—.90 T/M.
Shooting ...	28½	5.94	3½ min. per shooting period.
Changing Pan	36½	7.60	6.1 min. per pan chg.
Greasing ...	3	.63	
Timber	9½	1.98	
Rock	18	3.75	Not time of extra men.
Pan Line ..	32½	6.78	
Ratchet	2½	.52	
Drill and Tamp	6	1.25	
Miscellaneous	11	2.29	
Dismantle ..	42	8.75	
Loading End	1	.21	
Chunks	1½	.31	
Engine	82	17.07	Came loose during operation.
Total	480	100.00	

From the above summary a number of things may be determined, and when used in conjunction with the graph it is helpful in showing some of the delays.

It is important in taking a time study that things be recorded as they actually happen and as many explanatory notes taken as possible. The number of studies taken depends on the importance of the operation. It is well to take two or more studies to show an average day's run, then eliminate the more pronounced delays and then take another series to observe the results. When a certain unit is apparently not up to production, it is best because of varying conditions to make a separate study and not try to use one taken on another similar unit or one taken on the same unit but made under different conditions.

In conclusion, it is not expected that the "time study" is a "cure-all," but it can be used to get the facts.

MINE VENTILATION
(*From page* 45)

entirely by "breakthroughs" and line brattice is not altogether satisfactory. With all due respect to the practices and traditions of the industry, our experience has been that face ventilation can best be accomplished by the blower fan. In recognition of the additional hazards introduced by the blower fan, the Union Pacific Coal Company has established definite rules governing blower fan installation and operation. *Figures* 1 *and* 2 illustrate the permissible methods of installing blower fans. One of the principal arguments advanced against the use of blower fans is that of recirculation. Installed on the intake side of the air current, (well set back from the return) and being surrounded by a brattice, in our opinion, well insures against this recirculation. To further prevent this happening, a rule of installation provides "that the volume of air passing on the entry upon which blowers are installed shall be not less than two and one-half times of all blowers on the entry." These requirements in connection with the use of blower fans, together with other safety precautions such as, certified shot-firers (who make an examination of places with a flame safety lamp before shooting), rock dusting, water on cutter bars, etc., provides a measure of safety quite comparable to conditions found in other states and localities where blower fans are "taboo".

It is a matter of record that the State of Wyoming leads all other states in the percentage of mechanically loaded coal. In a large measure, this is probably due to the progressiveness and liberality of state mining laws and state inspection departments, and, in justice to the law and its officers, it might be pertinent to state that neither has been imposed upon and mine ventilation in the State of Wyoming will be found to compare favorably with that of any other state.

SAFETY DEPARTMENT
(*From page* 50)

department. A smaller and more concise set of rules has been published for the use of all mine workmen, every man receiving same required to receipt for and be governed by the instructions contained therein. No set of rules can be so comprehensive as to include all phases of all work so that, in the ultimate, each individual must be his own set of rules and constitute his own safety committee.

MACHINE INSTALLATIONS
(*From page* 43)

pumps at the upper station must run 22 hours daily to handle the water. Vertical triplex plunger pumps are used at the minor stations, and double-acting 6-in. x 6-in. piston-type pumps are used in most sinking operations.

At No. 4 mine, Hanna, two centrifugal pumps have been installed, replacing three large plunger pumps. These centrifugal pumps are duplicates and have a capacity of 450 gallons per minute against a head of 725 ft. One is placed near the bottom of the slope, while the other is at a point midway between top and bottom of slope. New sumps were made and so placed that all water flows to the pump by gravity. The top sump will hold three days' drainage, and when full exerts a pressure of 16 lbs. per sq. in. on the dam or stopping at the pump room. The lower sump will hold five days' drainage, allowing ample time for repair or other shut-downs. Each pump is driven by a 200-hp., 2,200-volt, 1,725-r. p. m. motor, which is protected against overload, low voltage, and open phase. All wires are in conduit, and the pump rooms are fire-proofed with cement stoppings and steel doors.

To improve the load factor on the power plant, these pumps are operated on the afternoon shift. They are started manually just before the end of the day shift, and automatic devices are depended on for stopping. Each pump is provided with two devices for this purpose. A Cutler Hammer pressure regulator is connected to the sump by a ¾-in. pipe, and when the water lowers so that only 12 in. of water covers the suction pipe, this regulator opens the oil switch, stopping the pump. A home-made mercury-operated device was installed to act in case of any failure of the regulator. It was made by forming a U tube from ½-in. pipe with an insulated contact placed in a pipe tee in one leg at the predetermined water level. The leg of U tube containing the contact was left open, while the other was connected to a low point on the sump. The U tube was then partially filled with mercury and pressure turned in to equal the above water level. Enough mercury was then added to just reach the contact. As the sump fills, the mercury is forced up into the open leg of the U tube .438 in. for each foot of water in the sump. When the pump is in operation and the receding water allows the mercury to seek its level it reaches a point where contact between the mercury and the insulated contact is lost, opening the oil switch and stopping the pump. As the pressure regulator is of the self-closing type, it has been equipped locally with a counter which records the number of times it has acted. When an attendant visits the pump room during the day he observes the number on the recorder, and if it did not operate the evening before the electrician's attention is called to it. These pumps operate approximately five hours daily.

Form 94 — Figure 1.

THE UNION PACIFIC COAL COMPANY

Daily Time Report, _____192__, _____ Mine No. _____

CHECK NO.	HOURS	RATE	AMOUNT	SPECIFY EXACT WORK PERFORMED	Account Number
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
HOURS					
AMOUNT					

Blank columns have been provided for Account Numbers

Fig. 1

NOTE: Report on back of this sheet changes in Rates, New Names, Deferred and Overtime.

Correct: _____ Checked and entered by: _____

Foreman

85 B-LABOR — Figure 3.

THE UNION PACIFIC COAL COMPANY

Distribution of Labor Performed, Other than for Mechanical Loading

Date _____192__ District _____ Mine No. ___

ACCOUNT NUMBERS	1	2	3	4	5	6	7	8
1 TO 35								
36 TO 60	36	37						
61 TO 90	61	62						
155 TO	155	156						
295 TO	295	296						

Fig. 3

Form 146

THE UNION PACIFIC COAL COMPANY

PAY ROLL NAME LIST

Mine _____ Month of _____ 192__

10-28 10M

CHECK No.	NAME	OCCUPATION	HOURS PER SHIFT	RATE Per Month	RATE Per Hour or Shift
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					

Approved: _____

Superintendent

Fig. 2

Form 89 - First Sheet — Figure 4.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—MINE OPERATION
ACCOUNT NO. I

ACCT		MEN	HRS	COST TODAY	COST TO DATE
	SUPERINTENDENCE				
1.	Superintendent				
2.	Clerks				
3.	Master Mechanic and Chief Electrician				
4.	Engineering				
	Total Superintendence (Accounts 1 to 4 inc.)				
	MINING				
5.	Pick Mining Tons @				
	" "				
	" "				
6.	Machine Mining Tons @				
	" "				
	" "				
7.	Yardage Yards @				
	" "				
	" "				
8.	Loading Co. Coal, Tons				
9.	Shot Firers and Blasters				
10.	Drillers				
11.	Powdermen				
12.	Dead Work				
13.	Mechanical Loaders (Details shown above)				
14.					
15.					
	Total Mining (Accounts 5 to 15 inc.)				
16.	DEVELOPMENT				
17.	HAULAGE Hoistmen, Rope Riders, and Roller men				
18.	" Motormen, Drivers, Partingmen, Spraggers				
19.	" General				
	Total Haulage (Accounts 17 to 19 inc.)				
	HOISTING AND RAILROAD CAR LOADING				
20.	Hoisting and Plane Engineers				
21.	Pushers, Motormen, Trip Riders, and Greasers,				
22.	Tipplemen, Car Droppers, Trimmers, Box Car Loaders, Slate Pickers, Screeners.				
23.	Weigh Boss, Dock Boss				
24.					
	Total Hoisting and R.R. Car Loading (Accounts 20 to 24 inc.)				
	VENTILATION				
25.	Doors and Brattice, Stoppings, Fans				
26.	Overcasts and Undercasts				
27.	Cleaning Air Courses				
28.					
	Total Ventilation (Accounts 25 to 28 inc.)				
29.	TIMBERING				
30.	TRACK LAYING				
31.	DRAINAGE				
32.					
	GENERAL INSIDE				
33.	Mine Foreman and Assistants (Day and Night)				
34.	Gas Watch and Patrol				
35.	Handling Material and Tools				
36.	Brushing, Handling Gob, Squeeze, etc.				
37.	Partings, Grading, Switches, etc.				
38.	Cleaning Roads, Falls, etc.				
39.	Recovering Material				
40.	General				
41.					
42.					
	Total General Inside (Accounts 33 to 42 inc.)				
	GENERAL OUTSIDE				
43.	Outside Foreman				
44.	Watchmen and Janitors				
45.	Yardmen, Teamsters, Laborers				
46.	Bath House Attendant				
47.	New Tools and Equipment				
48.	Blacksmithing and Bit Sharpening				
49.	Electric Cap Lamps				
50.	General				
51.					
52.					
	Total General Outside (Accounts 43 to 52 inc.)				
	TOTALS				

Figure 2.

DAILY COST ACCOUNTING for Coal Mines

By FRANK TALLMIRE *

Classification of principal factors of a coal mining cost sheet—Brief comparison between accounting methods for hand and mechanical loading—Complete forms for all labor and material records and cost statements.

THE economical operation of a coal mine, regardless of the methods used, can be accomplished only by close supervision not only on the part of the superintendent, the foreman and his assistants who come in daily contact with actual performance of the work, hut also by the general officers who may be located at considerable distances from the plant, and who, therefore, can exercise only infrequent supervision.

To be intelligent and effective, supervision must be supported by a knowledge of the facts, and such knowledge can be acquired mainly through written records and reports of what is actually taking place, and the results that are being obtained. It is not sufficient that written reports be available only monthly or even weekly; to he valuable they must he compiled and acted upon daily.

Of the 11 active mines of The Union Pacific Coal Company, the hand loading method is still used in two; four have been entirely mechanized, that is, all of the loading is done by machines, while in five, both mechanical and hand loading methods are used. In order that the management, both at the mines and at the general offices, may have up-to-date information, not only of costs but also of other essential items of operations, a system of daily reports has been provided, which is briefly explained and illustrated below:

A classification has been made of the principal factors comprising coal mining costs, the general accounts being:

I. Labor—mine operation.
II. Lahor—mine maintenance and repairs.
III. Lahor—mine safety work.
IV. Material—mine operation.
V. Material—mine maintenance and repairs.
VI. Material—mine safety work.
VII. Power

These general accounts have been subdivided into several primary accounts covering practically every item of coal mining operations. The charges to these various accounts are distributed, assembled and reported on a daily cost statement, one copy of which is sent to the office of the president, one to the office of vice president and general manager, and one is retained in the office of the mine superintendent. As of the last day of each month, a copy is sent to the accounting department where the information shown thereon is summarized and used in the preparation of general statistical reports. A brief description of the forms and data entering into the preparation of the daily cost statement follows.

LABOR

As labor constitutes the greater part of cost of mining coal, provisions have been made for recording and reporting labor payments in more detail than other cost items. In mines where hand loading method only is followed, time worked by individual employes is reported by the foreman on Form 94, "Daily Time Report" (*Figure 1*). No names appear on this report, employes' "check" or identification numbers having been assigned at the beginning of each pay period and recorded on Form 146, Pay Roll Name List (*Figure 2*). The foreman enters check number, hours, rate and amount; distribution to the appropriate accounts is made by mine office clerks. Charges to various accounts on Form 94, are abstracted on Form 85-B, Distribution of Labor performed, Other Than for Mechanical Loading (*Figure 3*), and from that form transferred to corresponding accounts on the Daily Cost Statement, Form 89 (*Figures 4 to 13, inclusive*).

For labor paid on a tonnage hasis, weight of each mine car of coal is inserted as to employes' numbers on Form 93, Weights of Coal Mined (*Figure 14*), by the weighman, and summarized and transferred to accounts 5 and 6 on the Daily Cost Statement (*Figure 4*), by the mine office clerks.

Labor paid for on a yardage basis is entered in Form 80, Report of Yardage (*Figure 15*), hy the mine foreman; calculations are made and amounts are transferred to proper account on the Daily Cost Statement (Acct. 7, *Figure 1*), by mine office clerks. Actual measurements are made only once in each pay roll period; estimates are made each day for cost purposes and adjustments to actual figures are made at the end of each period.

Mechanical loading being comparatively new and entailing the expenditure of large sums of money, requires additional observation and intensive analysis in order to obtain the best results. For those reasons, while labor and material costs for mechanical loading have been assigned separate accounts (Nos. 13, 58, 91 and 121) on the Daily Cost Statement, these four accounts have been subdivided to reflect the principal classes of labor and material entering into mechanical loading operations, and a timekeeper has been placed in the mines where mechanical loaders are installed. A special Daily Time Report, Form 94-A (*Figure 16*), bas been provided for mines where mechanical loaders are used, which is prepared by the timekeeper, who also cooperates with the

* Auditor, The Union Pacific Coal Company.

Figure 5.

Form 89 - First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

LABOR-MAINTENANCE AND REPAIRS TO ACCESSORIES TO MECHANICAL LOADING (DETAILS OF ACCOUNT NO. 53)					
ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
53a	Mining Machines				
b	" " Cables				
c	Electric Drills				
d	" " Cables				
e	Blasting Machines				
f	Signals and Lines				
g	Blower Fans				
h	" " Tubing				
i	General Overhauling of Mechanical Loaders				
j					
k					
	TOTALS				

LABOR-MINE MAINTENANCE AND REPAIRS ACCOUNT NO. II					
ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
53.	MAINTENANCE AND REPAIRS OF ACCESSORIES				
54.	ELECTRIC PLANTS (Outside)				
55.	SUBSTATIONS				
	MINING MACHINES AND DRILLS				
56.	Mining Machines and Cables (Other than Acct. 53)				
57.	Drills and Cables (" " " 53)				
	Total Mining Machines and Drills (Accts 56-57)				
58	MECHANICAL LOADERS (Details shown above)				
	HAULAGE EQUIPMENT				
59.	Trolley Lines, Feed Lines, and Bonds				
60.	Locomotives and Hoists				
61.	Pit Cars				
62.					
63.					
	Total Haulage Equipment (Accts. 59 to 63 inc.)				
	HOISTING AND R.R. CAR LOADING EQUIPMENT				
64.	Tipple, Box Car Loader, and Scales				
65.	Main Hoist				
66.					
	Total Hoisting & R.R. Car Load. Equip. (Acc. 64-66 inc.)				
	VENTILATION				
67.	Blower Fans, Inside (Other than Acct. 53)				
68.	Ventilation Fan (Outside)				
	Total Ventilation (Accounts 67 & 68)				
69.	DRAINAGE				
	BUILDINGS AND STRUCTURES				
70.	Dump and Tipple				
71.	Shop Buildings, Hoist House, Warehouse, and Fan House.				
72.	Bath House				
73.	Office and Other Buildings				
74.					
	Total Buildings & Structures (Acct's 70 to 74 inc.)				
	MISCELLANEOUS EQUIPMENT				
75.	Telephone, Light, and Signal Lines				
76.	Bath House Equipment				
77.	Automobiles and Trucks				
78.	Equipment made in Company Shops				
79.	Miscellaneous				
80.					
	Total Miscellaneous Equipment (Accts. 75-80 inc.)				
	TOTALS				

Fig. 5

Figure 6.

Form 89-First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

LABOR-MINE SAFETY WORK ACCOUNT NO. III					
ACCT.		MEN	HRS.	COST TODAY	COST TO DATE
81	Supervision				
82.	Sprinkling				
83	Rock Dusting				
84.	Barriers, Gates, Signs, Refuge, Man Holes, etc.				
85.	Safety Lamps, (Flame)				
86.	Apparatus and First Aid				
87.	Examinations and Inspections				
88.	Sampling Dust & Air				
89.					
90.	General				
	TOTALS				

Fig. 6

MATERIAL- MINE OPERATION ACCOUNT NO. IV			
ACCT.		COST TODAY	COST TO DATE
91.	Mech. Loader Operation (Details shown above)		
92.	Explosives (Other than above)		
93	Timber, Props, Bars, Chutes (" " ")		
94.	Brattice Materials, Stoppings (" " ")		
95.	Lubricants, Packing, Waste, etc. (" " ")		
96.	Feed and Care of Stock		
97.	Sand, Sprays, Gasoline for Locomotives		
98	Rails		
99.	Ties		
100.	Spikes, Plates, Frogs, Rollers, etc.		
101.	Haulage Ropes, Steel, Hemp (Other than Mech. Loaders)		
102.	Tile, Sand, Cement, Overcoats, etc.		
103.	Drainage		
104.	Blacksmith Supplies		
105	Machine Shop Supplies		
106.	Electric " "		
107.	Hand Tools and Equipment		
108.	Lamps, Lights, Signal, and Tel. Lines.		
109.	Office Supplies		
110.	Water		
111.	Coal, Water, and other materials for the Bath House		
112.	Fuel		
113.	Mine Fires, Floods, Disasters, etc.		
114	Hand Tools, Shovels, Picks, Drills, etc.		
115.	Electric Cap Lamps		
116.			
117	General		
118.			
119			
	TOTALS		

Fig. 6

Figure 7.

Form 89-First Sheet
SUPERINTENDENT'S DAILY COST STATEMENT

MATERIAL - MAINTENANCE AND REPAIRS TO ACCESSORIES TO MECHANICAL LOADING (DETAILS OF ACCOUNT NO. 120)			
ACCT.		COST TODAY	COST TO DATE
120a	Mining Machines		
b	" " Cables		
c	Electric Drills		
d	" " Cables		
e	Blasting Machines, Signal Lines, etc.		
f	Blower Fans and Tubing		
g	General Overhauling of Mechanical Loaders		
h			
i			
j			
	TOTALS		

Fig. 7

MATERIAL - MINE MAINTENANCE AND REPAIRS ACCOUNT NO. V			
ACCT.		COST TODAY	COST TO DATE
120.	Maintenance and Repairs of Accessories (Account 211)		
121.	Mechanical Loaders (Details shown above)		
122.	Mining Machines and Cables (other than Account 120)		
123	Blower Fans and Tubing (" " " 120)		
124.	Drills and Cables (" " " 120)		
125.	Cables, M. Mach., Drill, etc. (" " " 120)		
126.	Power, Feed, Trolley Lines, Bonds		
127.	Electric Plant (Outside)		
128.	Substations		
129	Locomotives and Inside Hoists		
130.	Hoists (Outside)		
131	Pit Cars		
132.	Tipple, Loading Equipment, Scales, etc.		
133.	Mine Fans (Main Air Course)		
134	Drainage		
135.	Dump and Tipple		
136.	Shop Bldgs., Hoist House, Warehouse, and Fan House		
137.	Bath House and Equipment		
138.	Office and Other Buildings.		
139	Light, Signal, and Telephone Lines		
140	Shop Equipment		
141.	Automobiles and Trucks		
142.	Wagons, Harness, etc.		
143.			
144.	General		
	TOTALS		

price, amount, and account chargeable are inserted on Form 79, amounts abstracted on Form 85-A for mechanical loading mines, and on Form 85-C, Distribution of Material Used, Other Than for Mechanical Loading (*Figure 19*), for hand loading mines, and transferred to corresponding accounts and sub-divisions on the Daily Cost Statement.

Power

Electrical energy consumed in the operations of The Union Pacific Coal Company is obtained from the company's own plants. A meter is installed at each mine and charges for power are made on mine foreman, unit foreman and others in making time studies and preparing data on each loading unit. Charges on Form 94-A are abstracted on Form 85-A, Distribution of Labor and Material to Mechanical Loading Units (*Figure 17*), and transferred to corresponding accounts and subdivisions thereof on the Daily Cost Statement by mine office clerks.

Material

Material is issued from the storeroom, warehouse or storage yard only on approved requisitions, Form 79, Requisition for Material (*Figure 18*). The

Form 89 - First Sheet

Figure 9.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—OPERATION MECHANICAL LOADERS
(DETAILS ACCOUNT 13)

LINE NO.	LOADING UNIT NO.	LOADING UNIT TYPE	MEN NO.	HOURS TOTAL	CUTTING HRS.	CUTTING AMOUNT	DRILLING HRS.	DRILLING AMOUNT	BLASTING HRS.	BLASTING AMOUNT	LOADING HRS.	LOADING AMOUNT	TIMBERING HRS.	TIMBERING AMOUNT	MOVING AND INST. HRS.	MOVING AND INST. AMOUNT	HANDLING ROCK HRS.	HANDLING ROCK AMOUNT	TODAY HRS.	TODAY AMOUNT	TO DATE HRS.	TO DATE AMOUNT
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						
10.																						
11.																						
12.																						
13.																						
14.																						
15.																						
16.																						
17.																						
18.																						
19.																						
20.																						
21.																						
22.																						
23.																						
24.																						
25.																						
26.																						
27.																						
28.																						
29.																						
30.																						
TODAY																						
TO DATE																						
¢ COST PER TON																						
PREVIOUS MONTH																						

NOTE: Items

Fig. 9

Form 89-First Sheet

Figure 10.

SUPERINTENDENT'S DAILY COST STATEMENT

LABOR—MAINTENANCE MECHANICAL LOADERS
(DETAILS ACCOUNT 58)

LINE NO.	MEN NO.	HOURS TOTAL	MECHANICAL HRS.	MECHANICAL AMOUNT	ELECTRICAL HRS.	ELECTRICAL AMOUNT	TODAY HRS.	TODAY AMOUNT	TO DATE HRS.	TO DATE AMOUNT
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18.										
19.										
20.										
21.										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										
TODAY										
TO DATE										
¢ COST PER TON										
PREVIOUS MONTH										

Fig. 10

Form 89-First Sheet

Figure 8.

SUPERINTENDENT'S DAILY COST STATEMENT

MATERIALS—MINE SAFETY WORK
ACCOUNT NO. VI

ACCT.		COST TODAY	COST TO DATE
145	Rock Dust		
146	Sprinkling Lines, Fittings, Hose, etc.		
147	Barriers, Gates, Signs, Refuge Places		
148	Safety Lamps (Flame)		
149	Apparatus and First Aid		
150	Fire Extinguishers, Hose, etc		
151			
152			
153			
	TOTALS		

Fig. 8

PROPORTION OF COST OF POWER
ACCOUNT NO. VII

ACCT.		COST TODAY	COST TO DATE
154	Power		
	TOTALS		

SUMMARY OF PRODUCTION COST

	TODAY	TO DATE	PREVIOUS MONTH
Labor: Mine Operation Acct. I			
" " Maintenance and Repair Acct. II			
" " Safety Work. Acct. III			
Total Mine Labor			
Material: Mine Operation Acct. IV			
" " Maint. & Repair Acct. V			
" " Safety Work Acct. VI			
Total Mine Material			
Power Acct. VII			
TOTAL COST			
Labor: Operation per M.R. Ton			
" : Maint. & Repair per M.R. Ton			
" : Safety per M.R. Ton			
Total Labor per M.R. Ton			
Material: Operation per M.R. Ton			
" : Maint. & Repair per M.R. Ton			
" : Safety per M.R. Ton			
Total Material per M.R. Ton			
Power per M.R. Ton			
TOTAL MINE COST			
MECH. LOADER COST PER TON ALL UNITS			
RATIO LOADER COST TO TOTAL			

Form 93

Figure 14.

Weights of Coal Mined at _____ Mine No. _____

The _____ day of _____ 192__.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119

Columns have been provided for 200 check numbers

Fig. 14

Figure 11.

Form 89-First Sheet

SUPERINTENDENT'S DAILY COST STATEMENT

MATERIAL—OPERATION MECHANICAL LOADERS
(DETAILS ACCOUNT 91)

LINE NO.	EXPLOSIVES	TIMBER	VENTILATION FANS, TUBES	POWER CAB. & LINES	LUBRICANTS	MECHANICAL	ELECTRICAL		TODAY	TO DATE
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										
15.										
16.										
17.										
18.										
19.										
20.										
21.										
22.										
23.										
24.										
25.										
26.										
27.										
28.										
29.										
30.										

Fig. 11

MATERIAL—MAINTENANCE
MECHANICAL LOADERS
(DETAILS ACCOUNT 121)

MECHANICAL	ELECTRICAL		TO DAY	TO DATE

Figure 13.

Form 89-First Sheet

SUPERINTENDENT'S DAILY COST STATEMENT

MEMORANDUM OF UNUSUAL EXPENDITURES

LABOR ACCT.	MEN	HRS.	COST TODAY	COST TO DATE	MATERIAL ACCT.	COST TODAY	COST TO DATE
TOTALS					TOTALS		

Fig. 13

NOTE:

Explain the nature and necessity of unusual expenditures, showing the numbers of the accounts charged. Carry cumulatively for the month and explain in detail on report for the last day of month.

-REMARKS-

Form 89-First Sheet

Figure 12.

SUPERINTENDENT'S DAILY COST STATEMENT

LINE NO.	MECHANICAL LOADER TONNAGE		UNIT COST PER TON TO DATE					POWER * (Estimated)			PROPORTION * ACCOUNTS 55 AND 120			TOTAL COST PER TON	MAN HOURS		CUMULATIVE MAN SHIFTS	TONS PER MAN SHIFT	OPERATING SHIFT DAY, NIGHT, DOUBLE	MEN'S SHIFTS	LINE NO.
	TO DAY	TO DATE	OPERATN LABOR	MAINT. LABOR	OPERATN MAT'L	MAINT. MAT'L	TOTAL	AMOUNT		PER TON	AMOUNT		PER TON		TO DAY	TO DATE					
1																				1	
2																				2	
3																				3	
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					
21																					
22																					
23																					
24																					
25																					
26																					
27																					
28																					
29																					
30																					

Fig. 12

Figure 13.

Form 80

THE UNION PACIFIC COAL COMPANY

REPORT OF YARDAGE

FOR PERIOD _____ 192__

CHECK NUMBER AND NAME	KIND OF WORK	LOCATION ROOM, ENTRY, ETC.	MEASUREMENTS STARTING POINT	MEASUREMENTS PRESENT (FEET)	MEASUREMENTS PREVIOUS (FEET)	DIFFERENCE FEET	DIFFERENCE YARDS	WIDTH	RATE	AMOUNT
Check No.____										
Check No.____										
Check No.____										
Check No.____										

CORRECT: _____ FOREMAN

CHECKED AND ENTERED BY _____

Fig. 15

Figure 14.

Form 71

REQUISITION FOR MATERIAL

Standard 7-28-500 Blks

No.____

MATERIAL CLERK:

PLEASE DELIVER TO BEARER THE FOLLOWING MATERIAL: _____ 192__

QUANTITY REQUIRED	ARTICLES	For Use of Material Clerk: PRICE	For Use of Material Clerk: AMOUNT	IF USED AND FOR WHAT PURPOSE TO BE USED	ACCT. NO.

APPROVED: _____ MINE SUPT.

SHOW ONLY ONE ITEM OF MATERIAL ON EACH LINE

NO MATERIAL TO BE ISSUED ON THIS ORDER UNLESS THIS BLANK IS PROPERLY FILLED OUT.

Fig. 18

Figure 16.

94-A

THE UNION PACIFIC COAL COMPANY

Daily Time Report Mechanical Loading, Date _____ 192__

District _____ Mine No. ____.

Check No.	Hours	Rate	Amount	Loading Unit	Cutting Hrs.	Cutting Amount	Drilling Hrs.	Drilling Amount

Form 85-C-Material — Figure 19.

THE UNION PACIFIC COAL COMPANY

Distribution of Material Used, Other Than for Mechanical Loading.

ACCOUNT NUMBERS	91	92	93	94	95	96	97	98
91 TO 117								
	118	119	120a					
118 TO 135								
	136	137	138					
136 TO 162								
	163	164	165					
163 TO								
	298	299	300					
298 TO								

Fig. 19

Form 89-Second Sheet — Figure 20.

SUPERINTENDENT'S DAILY COST STATEMENT

ACCT. No.	POWER PLANT	No. MEN	HOURS WORKED	LABOR: COST TODAY	LABOR: COST TO DATE	LABOR: COST TO DATE PREVIOUS MONTH	MATERIAL: COST TODAY	MATERIAL: COST TO DATE	MATERIAL: COST TO DATE PREVIOUS MONTH
	SUPERINTENDENCE								
166	Proportion of Superintendence								
	PRODUCTION								
167	Turbine Room Operation								
168	Boiler Foreman								
169	Boiler Firemen								
170	Coal to Boilers								
171	Cleaning Boilers								
172	Ash Handling								
173	Waste								
174	Lubricants and Waste								
175	Tools and Appliances								
176	Power from Central Plant								
177	Purchased Power								
178	General								
	MAINTENANCE AND REPAIRS								
180	Buildings								
181	Pipe and Steam Lines								
182	Electric Lines								
183	Ash Disposal System								
184	Boilers and Superheaters								
185	Stokers								
186	Coal Conveyor								
187	Pumps								
188	Fans								
189	Cooling Pond and Tower								
190	Turbines								
191	Engines								
192	Generators								
193	Exciters								
194	Condensers								
195	Switchboards								
196	Transformers and Arresters								
197	Transmission Lines—General								
	Transmission Lines—Terminals								
198	General								
199	Depreciation								
900	Insurance								
901	Property Retired								
	Total								
	DISTRIBUTION K. W. H.								
	Generated								
	Cost per K.W.H.								
	Reliance Mines								
	Winton Mines								
	Superior Mines								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Water Plant								
	Small Dust Plant								
	Real Estate Dept.								
	Merchandise Dept.								
	General Office								
	Company Employes								
	Other Uses								
	Total								

Fig. 20

Figure 21.

ACCT. No.	WATER PLANT	No. MEN	HOURS WORKED	LABOR: COST TODAY	LABOR: COST TO DATE	LABOR: COST TO DATE PREVIOUS MONTH	MATERIAL: COST TODAY	MATERIAL: COST TO DATE	MATERIAL: COST TO DATE PREVIOUS MONTH
	SUPERINTENDENCE								
214	Proportion of Superintendence								
	OPERATION								
216	Pumpmen								
217	Delivering Water								
218	Purchased Water								
219	Properties of Power								
220	Coal								
	MAINTENANCE AND REPAIRS								
222	Pipe Lines and Hydrants								
225	Reservoirs and Tanks								
224	Pumps								
223	Electric Equipments								
226	Buildings and Structures								
227	Depreciation								
228	Insurance								
	Total								
	DISTRIBUTION								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Mine No.								
	Power Plant								
	Merchandise Dept.								
	Real Estate Dept.								
	Company Employes								
	Other Uses								
	Total								

Fig. 21

a kw. h. basis. Details of the cost of operating the plant by which the cost of producing power is determined, are reported daily on the second sheet of the Daily Cost Statement (*Figure 20*), and the proportion chargeable to cost of mining is carried to General Account VII, on the first sheet.

At Rock Springs, Wyo., the company owns and operates a pumping plant which is used as an adjunct to the power plant only, water for domestic purposes being obtained from an outside company. At Hanna and Reliance, Wyo., water for all purposes is purchased from outside companies. At Winton, Superior and Cumberland, Wyo., the company owns and operates water plants which supply water for mining operations and other purposes. Where the company owns and operates pumping plants and distribution systems, the expenses of operating them are classified and reported daily on the second sheet of the Daily Cost Statement (*Figure 21*), the proportion chargeable to cost of production of coal being carried to the first sheet. Account 110 (*Figure 6*).

Expenses of other operations not entering directly into the cost of mining, such as dwelling houses for employes, amusement halls, community buildings, hospital and medical services, prospecting, new construction, etc., are also reported on the second sheet of the Daily Cost Statement.

Briefly then the cost of all mining operations of this company have been finely classified and reported daily to both the local and general managements, figures for "today" and cumulative figures from first of month to date being shown. It is necessary to estimate certain charges; in such cases, however, adjustments to actual figures are made at the end of the month. To some operators, even those who are quick to adopt modern machinery and mining methods, an extensive classification and daily reporting of costs may seem like undue refinement and an unnecessary mass of statistics. Other operators, however, recognize the value of up-to-date facts, and will not wait until several days after the end of the month for statistics regarding the conduct of the business for which they are responsible.

MATERIAL DEPARTMENT

By W. K. LEE *

Methods for requisitioning purchasing and distributing equipment and supplies—Card records

THE purpose of the Material Department is to provide material needed, and to properly, promptly and economically care for, handle and account for all such material. The Material Department is in charge of the purchasing agent, and a material clerk is stationed at each one of the six properties.

The heads of the different departments designate the material desired in a "Want Book" located in the material room or store house. From this "Want Book," the material clerk enters the items on a requisition. This requisition, in addition to describing the items and showing the quantity desired, designates the quantity of such items used the preceding month, quantity on hand, the purpose for which intended, and the approximate unit cost of same. The requisition then goes to the mine superintendent for signature, after which it is forwarded to the general offices where it is carefully scrutinized by the various officials, approved and then sent to the purchasing agent.

In the Purchasing Department, the requisition is registered and numbered, and the material clerk from whom it originally emanated is advised of the number on a special form. Formal orders are then made up covering the purchase of the different items, showing, in addition to the order number, the requisition number, and instructing the shipper to quote both numbers on their invoice and to be marked or tagged to the material shipped. A copy of the order is forwarded to the material clerk.

All shippers are instructed to mail their invoices in triplicate and forward same to the purchasing agent and not to the point to which the material is shipped. Upon receipt of the invoices in the Purchasing Department, they are numbered, and the original and duplicate are forwarded to the material clerk receiving the material and the triplicate is retained by the purchasing agent. Upon receipt of the material in good order, the material clerk approves the invoices and forwards the original to the Accounting Department where a voucher in payment is drawn and forwarded to the shipper. In cases where a cash discount is allowed for payment of an invoice within a limited time, the original is forwarded direct to the Accounting Department by the purchasing agent for immediate payment.

A card record is kept of all material received, a separate card being on file for each item. In addition to showing the purchasing agent's number of the invoice and the order and requisition numbers, an entry is also made on the card whenever any of the material is issued, so that by referring to the card the material clerk knows the quantity of any given item he has in stock. The entries of material issued are made on the card from a special form rendered by the heads of the different departments and given to the material clerk in exchange for the material they receive from him.

The material clerk submits a list once every month showing all surplus or slow-moving material that he may have on hand. A copy of this list is forwarded to each of the other material clerks, with instructions to order therefrom whenever possible. A copy is also retained by the purchasing agent, so that he may move some of the surplus material to other mines whenever possible.

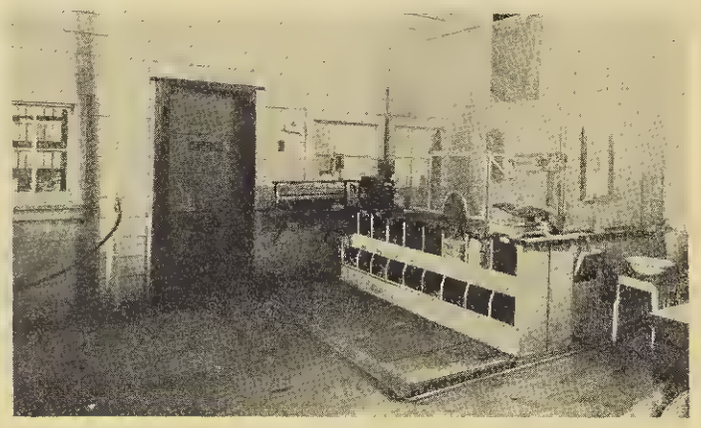
All material is inventoried once each year. However, several check inventories are taken between the general inventories.

All requisitions covering stationery purchases are handled in the same manner as those covering material, except that they are all made by one material clerk and the stationery is all kept at one point, the other material clerks getting their requirements from this stock.

A separate card record is kept of all items designated as "equipment"; that is, motors, pumps, hoists, drills, mining machines, lathes, fans, etc. This card gives a complete description of the item, including serial number, date and from whom purchased, order and requisition number and purchasing agent's invoice number, and (*Continued on page* 68)

* Purchasing Agent, The Union Pacific Coal Company.

Portion of general material room where stationery and mine supplies are stored



Disbursing counter in general material room at Rock Springs

The Trend Toward Better Living Conditions for Employes

By GEO. B. PRYDE *

Early conditions—First attempt toward improvements—Mining towns are now modernized and employes enjoy same advantages as in large communities—Views of towns, dwellings and gardens

IN THE early days of coal mining in southern Wyoming where mines were opened by the Coal Department of Union Pacific Railway Company, later known as The Union Pacific Coal Company, the employes were composed largely of British immigrants. These men had learned the art of coal mining in their native land, and, being of an adventurous spirit, they sought to better themselves in the great West, which was then being opened by the extension of the Union Pacific Railway westward.

Coming from a beautiful country where verdure of every kind was abundant, it was a rude awakening for them and their families to be set down in the desert country of southern Wyoming. The result was they became dissatisfied on account of homesickness, and their entire efforts were predicated on wresting a competence from the new land, then returning to their native heath—"to God's country."

Such a state of mind was not conducive to any permanent plans of living, either temporal or spiritual. The result was that none planned beyond their immediate personal needs and living conditions were of the most primitive kind. Falling in with this attitude, the employing company which originally entered the field, as well as those who came later (although all should have known better), fell into the same habit of insecurity, that here indeed "they had no abiding city." And so mines were opened up in a rather antiquated manner from the abundant coal outcropping on the hillsides.

The early coal mining towns consisted of an aggregation of shacks with two and three room tenements. These were often unpainted and little thought was given to planning any improvements thereon, being bleak and barren at their best, and so the mining towns presented a rather depressing picture. It was generally accepted by employer and employe alike that the climate was such that it would not permit of any successful attempt to improve on nature by planting trees, or the growing of vegetables, grass or flowers.

As the West settled, labor shortages developed with considerable frequency, and as the early employes had come to regard Wyoming as a not altogether bad place to live, our company was compelled to give consideration to the improvement of living conditions by providing better housing facilities, and giving more thought to making the mining town more attractive. While not an innovation, prizes were offered for the best gardens. This was quite an uphill job at first, as the old idea still persisted that southern Wyoming with its short-growing season and climate was not adapted to cultivation of the soil.

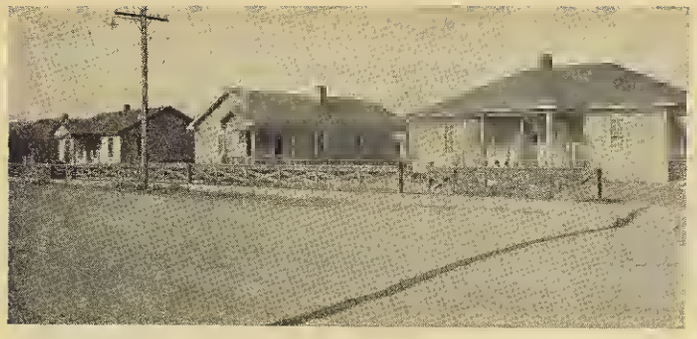
Eventually, a few pioneers showed what could be done with a liberal amount of hard work and optimism. Others became encouraged and fell in line and some wonderfully beautiful gardens have been developed. The building of fences has greatly assisted this effort, as people in a mining community like to have their yards properly enclosed as a measure of privacy and to protect the gardens from marauding bands of live stock. The photographs show what can be done in southern Wyoming. True it takes a great deal of hard work plus lots of faith, but the results speak for themselves.

During the last four years a persistent and extensive program of painting our houses has been undertaken. A number of standard colors were adopted, with much more pleasing results than the painting of all houses a stereotyped color. Many of our employes came from countries where the brighter colors in dress predominate and so the variegated painting appeals to them. All roofs are

* Vice President, The Union Pacific Coal Company.

Lawn and flower garden, Cumberland, Wyo.

Employe's garden, Reliance, Wyo.



Type of modern houses at Rock Springs

Houses at Winton, recently modernized

painted green, first as a protection to the shingles, and second as a contrast to the bareness of the scenery contiguous to our mining towns. All painting has been done by the air brush method, as many as four units heing in operation at the respective towns during the summer months. This has been found to be an extremely rapid and economical method of doing the work. During the four-year period we have expended annually for this painting almost $15,000.

The building of bath houses in all of our mining towns has proved a wonderful convenience for the employes. Several of the bath houses have been equipped with bathing facilities for women and children. Wherever adopted, this system has worked out quite successfully. A start bas been made toward modernizing tenements, and this work will be continued, there being a growing demand among our employes for houses modernly equipped. Concrete sidewalks have been a great convenience to our employes, particularly during stormy weather. This work has had a good start and will be continued until all of the principal streets in our mining towns have heen so provided.

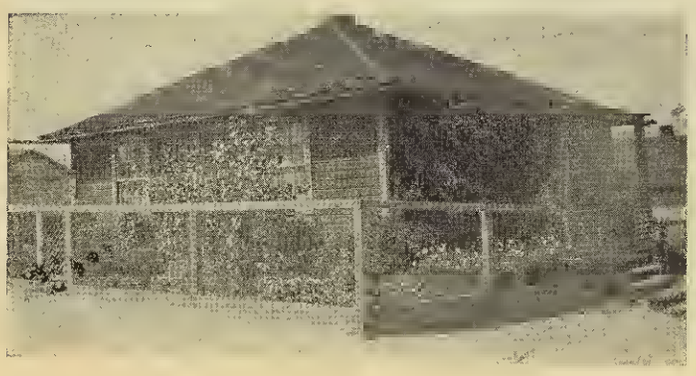
An experiment tried during the period of slack work last summer was so successful that it is planned to continue it during the summer of 1930. The common practice is to lay the mines idle for short periods each week to conform to the lessened summer demand for coal. We had figured tbat it would he a convenience to our employes if they could have an extended vacation of 10 to 14 days, instead of periodical short vacations with a large amount of absenteeism. The system worked out very well and our employes had an opportunity to be away with no loss of earnings, as, during the period of two months in

In a Rock Springs garden

which vacations were allowed, the working time of each district was equalized. It developed in some cases that a two-weeks' vacation was somewhat long, probably a 10-day period would be more satisfactory.

Our mining communities, in common with all other parts of the country, have benefited immeasurably from inventions that have been developed: (1) electrical appliances have made lighter the work of the housewife, particularly has it hanished the spectre of the weekly wash day by the introduction of the electric washer and iron. (2) The movie has brought the far places of the eartb close to home, the recent adaptation of the "Talkie" has made it possible to hear good plays and the best of music. (3) The radio has brought mining communities in contact with many remote parts of our own and other countries until the world seems a small place after all. During the long winter evenings, in this manner, many of our employes are kept in close touch with literature, music, art, politics, religion and many other subjects, and, the many improvements yet to be made in radio, will add greatly to this form of entertainment. (4) The auto, no doubt, has been the one great means whereby the horizon of the average mining community has been enlarged. It has provided a convenient and rapid method of transportation between communities, between towns and hetween states. During the summer months, particularly, it allows many families to spend much time in the open air.

And so, the combination of what has been done to improve the conditions in our mining communities, together with the advantages of new inventions, is rapidly changing the old mining towns into places with pleasant and agreeable surroundings.



House at Superior and garden at Hanna, Wyo.

COMMUNITY ORGANIZATIONS in the Towns of The Union Pacific Coal Co.

By JESSE MCDIARMID *

Aims and activities of various social organizations—Boy and Girl Scouts—Old Timers Association—Sunday school—Bands and other recreational activities

COMMUNITY organization rather than any form of institutionalism might perhaps express the policy of The Union Pacific Coal Company in relation to the "social activities" that are projected in its towns. We recognize that not only must the level of community participation be reached in making plans as well as in "activity", but that the success of a project depends on whether or not independence, resourcefulness, initiative and the capacity for cooperation are encouraged in the working group and in the individual members of the community. A coal village is a small social world in itself. Last winter an editorial in a national paper, commenting on a critical situation in the coal industry called coal districts "small kingdoms where owners rule supreme." Surely progress, here as elsewhere, involves the growth of democracy—democracy where the inherent dignity of every man is recognized; and where actions and thinking befitting that dignity are expected. This, then, as an objective—a community organized by itself for its own best interest. And for ourselves a sustained constantly receptive attitude toward the vague out-reachings of a community or group and a real awareness of the community building programs available in our state, from the state university or other public agency; of national programs for boys and girls. Nor are we passive parts of the community, but wish to be only one part, making vigorous if cautious advances, and avoiding the possibility of carrying even a good idea to the point of killing the spirit either of self-determination or of original effort by the trial and error method.

An opportunity to help any community involves a knowledge of the people in that community and perhaps our President knew the answer to the professional community worker's oft repeated and long sought quest for a "natural contact"; in any case the *Employes' Magazine* has made for us a natural and easy basis of acquaintance. And a closer contact with mining people has given us what we perhaps least expected, plenty of material on which to feed a growing belief in the inherent worth of folks. Just recently, while visiting, we picked up a book while our hostess went outdoors to settle some children's dispute. The book looked familiar and we found that it was one which was on the required reading list at our school some years ago and was considered a unique study of what was, at that time, an empire problem. We were lost in its pages when our hostess returned and said: "Do you know that? My cousin wrote it. He died in Africa——." We turned to the front page and read: "To my dear cousin—from the author A.—— C.——," with a Scottish address. We'd found a cousin of a book friend of our hero worshipping days, the cousin of a man who still is one of the heroes of an Empire's Church. We have found graduates of foreign universities. We have found heroes of the World War wearing first aid and mining community medals as proudly as they wear the honors of a nation's army. And we have found homes where the real fineness of a well

* Editor, Employes Magazine, The Union Pacific Coal Company.

There are 49 nationalities on the pay rolls of The Union Pacific Coal Company

McAuliffe's Pipe Band of Highland Scottish Pipers at the Union Pacific Company's Old Timers Association Annual Celebration

Pipers James Wallace, Alex Watt and James Noble, the beginning of the McAuliffe Scottish Pipe and Drum Band

ibred mother communicated itself to her children in spite of difficult associations. We have found natural leadership of boys and girls and, in a few years, have seen boys and girls, young men and women, the children of miners, make notable places in educational and musical fields. The exceptions? Perhaps, but among these is to be found real leadership for those programs that make up the "activities" of our coal towns. Nor does this leadership object to direction-suggestion. Rather have we found a pathetic eagerness for help whether it be in women's club programs or ideas for money-making parties. And, whether we've accomplished it in adequate measure or not, the primary interest of the professional social worker, of the industry using it, should be the assistance and training of that leadership. It must be acknowledged a serious fault to stimulate a desire to help and then permit, if it is possible to avoid it, the feeling of futility that accompanies the breakdown of plans because of personal unpreparedness. To illustrate: It is easy to arouse an interest in the leadership of a Girl Scout troop in, perhaps, a young school teacher. Leadership training should then be supplied sufficiently often to avoid a willing leader's feeling that she's come uncomfortably to the end of her resources in program planning. Sincerity and eagerness and ideals are not enough—the technique that projects them is necessary.

Community Councils

It was with something of the foregoing in mind that we organized, five years ago, community councils in each one of our towns. These councils were composed of one or more representatives elected from the organizations already existent in the town as: United Mine Workers of America Local Unions; fraternal and church organizations; women's clubs; school teaching staff; Sunday Schools, and Parent Teachers Associations with the local mine superintendent and the magazine editress as ex-officio members. Suggested skeleton constitutions were offered and were revised and changed by the group to suit the individual town. Provision was made for the inclusion of other organizations, "community-wide in their interest," which might come later and the councils vary in membership numbers and in the activities undertaken in each village. There is no attempt to impose a program of effort. Suggestions are given as suggestions and effort made to induce group discussion, group opinion, group achievement, group results. Thus the level of community participation is reached and—more—is raised by giving additional courage of expression to the best elements and efforts in the community, through council unity and backing.

Activities sponsored by councils accommodate themselves to all phases of neighborhood aspiration—recreational, social, vocational, dramatic, musical, philanthropic and civic. Such relief as is necessary is done through the council, the council itself acting as a case committee. And perhaps it, better than any other agency or individual available in a tiny mining town, does try to consider the causes of need in individual families, and "by appropriate treatment seek to restore such families to independence." In any case since all the organizations of the little community are working together duplication of relief, by which families may lose their independence, is avoided and some tiny bit of the personal service which helps to "prevent a recurrence of distress" is given. Thanksgiving and Christmas baskets are also arranged by councils' committees, working with committees from the local unions or being supplemented by additional members from the local unions. We should also mention that special pleas for help are made to and answered by local unions—but of these councils are made aware by the local union representatives on the council. Indeed "treatment" almost invariably involves the cooperation of the union local.

A small sum of money is given to the councils monthly by the coal company and it is interesting to learn that additional sums are raised and used, ranging from a like amount to five times the sum given.

Bands

Following the organization of a most successful community band maintained in the town of Cumberland, our community councils have promoted town bands in four villages, helping finance the purchase of the larger instruments and arranging for instruction and leadership, using, as in Cumberland, the full time of a band leader resident in the town; a professional leader of a near-by town as in Winton and Reliance; or non-professional leadership as in Hanna. These bands are a recreational joy to non-members in the communities. But their largest contribution comes because they are the educational incentive for so many of our young folks acquiring musical training. In Cumberland, last year, there were 45 high school students, 42 of whom were members of the community band. Our president has also promoted, and with the help of a Scottish vice president, a remarkable band of Scottish pipers, 10 in number, who call themselves "McAuliffe's Pipe Band."

Recreation

By far the largest share of the "activities" of our community councils may be classed as recreational. And, again, the value of councils carrying community-wide representation in the membersbip is seen. Instead of holiday celebrations being many and for small groups and sections of the town, the

community is considered as a whole and recreations planned to cover it And, to a considerable degree, the councils or individual organizations with the backing of councils, have taken over the conduct of such commercialized amusements as dances put on by visiting professional dance orchestras which may be followed by undesirables who, away from home, are less careful of their conduct. We recognize that that recreational activity which claims the largest number of active participants is the best recreation. Dancing, dancing games and pageantry are excellent examples of such recreation. It goes witbout saying, however, that dancing planned by a local group under the sponsorship and supervision of the community council, attended by old and young alike as a community celebration, is a more reasonable recreation than that put on by an outside orchestra for gain. And perhaps we may mention the additional advantage that the home-managed dancing party uses its funds for some piece of community work. And again, councils need awareness and

Sacred vessels from the old Chinese "Joss House" which the Chinamen donated to Mr. Geo. B. Pryde when they left for home

willingness for experimentation. And they do experiment. The town of Reliance carried, recently, a series of "old-time" dances, using a volunteer home orchestra and reviving old folk dances, early American dances and dancing games. At first the older young people did not attend, preferring to drive to the city, but before the series was over everybody was learning and enjoying the old dances. A public health nurse making a school health survey said that she believed much of the underweight and apparent undernourishment she found was really due to lack of sufficient sleep. She complained about the presence of young children at community gatherings and that they were allowed to remain until a late hour. The women's club of one town plans each year a New Year party, calling it a dance, for all tbe children of the community with the understanding that they will not attend the grown-up's party. And, this year, the Girl Scouts of the various towns will make the conduct of a children's games' Saturday afternoon during the Christmas holidays their "Second Class" bit of

Children's Day in the new Old Timers Community Building

community service. Modern psychology believes expression for the fundamental play instincts to be essential to the stability of the adult. And we have long believed that, "play is the serious business of childhood," not just a harmless means for filling the time not occupied by study or work to "keep them out of mischief," but ranking with education as part of the process by which normal development is assured. Play for everyone, an opportunity for wholesome good times through athletics, music, drama, and social activities should belong to any community.

Boy and Girl Scouting

The use of the national programs for Boy and Girl Scouts is in part an answer to the need for wholesome recreation, although certainly it is not the only fundamental need these programs meet. Boy and Girl Scout troops are conducted in our towns under the local sponsorship of community councils and the direction of the scouting councils of the district. These national programs are too well known to require comment here. We mention some district achievements. Last year 20 first aid teams, 13 teams of girls and 7 teams of boys, took part in the Scout section of the inter-company first aid meet doing work acknowledged by United States Bureau of Mines officers to be comparable to that of first aid men of experience. One hundred and twenty boys and girls working efficiently and fighting energetically in a contest which demonstrated expertness in an art which will stand them in good stead all their lives, enable them to render real service in out-of-the-way places—and (*Continued on page* 76)

Ten aged Chinamen who helped build The Union Pacific Railroad and, after a lifetime of service with it and with The Union Pacific Coal Company, are being sent home to China on retiring fund

Form 254

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

(Employment Department)

APPLICATION FOR EMPLOYMENT

GENTLEMEN: NO.

I hereby make application for employment as

I have had

experience in this line of work and refer you to

my last
present employer.

The following is record of my employment during the past three years.

I hereby authorize any of the above former employers to furnish The Union Pacific Coal Company my service record while in their employ and hereby release them, their officers, agents and employes, from any and all responsibility for so doing.

Witness.

NOTE—Applicant must state record of employment for the past three years.

References Hired for Date

Remarks

Nationality Date of Birth Marital Rel. Citizenship

Figure 1 (front)

STATEMENT OF DEPENDENTS

Wife.

Name

Age Date of Birth

Residence Occupation

Children

1. Name Sex Occupation
   Date of Birth Residence
2. Name Sex Occupation
   Date of Birth Residence
3. Name Sex Occupation
   Date of Birth Residence
4. Name Sex Occupation
   Date of Birth Residence
5. Name Sex Occupation
   Date of Birth Residence
6. Name Sex Occupation
   Date of Birth Residence
7. Name Sex Occupation
   Date of Birth Residence

Dependents Other Than Wife or Children

I am making the following regular contributions toward the support of:

Name Relationship

Residence

Occupation Age Contribution $

Per Remitted through

Name Relationship

Residence

Occupation Age Contribution $

Per Remitted through

I hereby certify that the above and foregoing is a full and complete statement of all members of my family and other dependents who are wholly or in part dependent upon me for support, as of 19

Signed

Witness

Figure 1 (back)

Form 256

NO.

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

REQUEST FOR REFERENCE and RELEASE

GENTLEMEN:—

has made application to this company for employment, and states that he was in your employ from to Occupation

Pay Roll No. at Plant, under foreman.

And that he left your employ

Will you please furnish us the following information regarding applicant's service record while in your employ, in accordance with attached Request for Reference and Release, and we will be pleased to reciprocate at any time. A stamped and addressed envelope is enclosed for your convenience in replying.

(Employment Department)

Was applicant in your employ during the above period?

Were his services satisfactory?

Reason for leaving your employ?

Would you re-employ?

Over

Figure 2 (front)

Form 255

THE UNION PACIFIC COAL CO.
WASHINGTON UNION COAL CO.

REFERENCE RELEASE

19

I have made application to

(Name of individual, company or corporation)

for employment in the capacity of

I was in the service of your company from to

as at and hereby request and authorize your officers to furnish said individual, company or corporation with a complete history of my services while employed by together with any information you may have concerning my personal character, habits, ability, disposition, etc., and particularly a statement of the cause or causes of my leaving the employ of your company including any statement of surmise or belief of any officials or employes of in connection therewith; and I fully understand and agree that the information furnished to be used as one of the means of determining my fitness for the position for which I have made application, and I hereby release you, its officers, agents and employes, the individual, company or corporation to whom you furnish the information above referred to, from any and all liability for damages of whatsoever nature or kind on account of furnishing the same.

Yours truly,

The signature of,

Insert name of Applicant Signature of Applicant

was made by him in my presence.

Figure 2 (back)

EMPLOYMENT of LABOR

By H. J. HARRINGTON *

Brief description of methods used in employing and placing new men—Past records and physical examinations—Application forms submitted

A DEPARTMENT organized exclusively for employment and introduction of workmen is a new departure from methods of employment that have generally obtained in the coal mining industry, and is a quite recent innovation in comparison with the efforts made along this line by other leading industries of the country which have, for a number of years past, given this branch of the business considerable thought and have profited to a great extent from the money and effort expended in organization and maintenance of departments of this character.

The employment department of The Union Pacific Coal Company was organized several years ago, but, due to considerable opposition to this new method and accompanying lack of cooperation, the hiring of new men was conducted on a hit or miss plan, no arrangement whatever being made to anticipate possible heavy demands for increase in working force, so that whenever a shortage of labor was apparent or business conditions required increased output with a corresponding increase in working force, this department was called upon to recruit immediately, and without any previous notice or preparation, the additional number of workmen that would be required to meet the emergency.

Under these conditions, it was necessary that we take into the organization such workmen as were available on short notice and without any consideration whatever of their previous record with this company or other employers.

Compilation and analysis of employment records, however, developed the extreme weakness of this system and pointed to the fact that we, as well as other employers of the district, were creating and promoting the growth of a highly undesirable class of floating or itinerant workers, and producing an unusually high percent of turnover, with attendant heavy cost for time expended by clerks, mine foremen and superintendents in recording, introducing and instructing this class of workman, and indicated that some definite steps should be taken to cure this condition and to eliminate this class of workman; that individual records, giving a complete history over a reasonable period of previous employment with this company or other employers of applicant, should be available for guidance of the employment department in selection of new employes. Out of this has grown the present code of rules governing employment with this company.

Our rules governing the employment of workmen now provide:

That all workmen required for service in the mines of this company shall be hired through a central office at Rock Springs; modified, however, to meet possible emergency at Hanna, Wyo., and Cumberland, Wyo., mines.

That continuous good conduct is necessary to maintain the relation of employer and employe; that poor or indifferent attendance, without reasonable cause, intemperance, or behavior prejudicial to good citizenship will disqualify applicant or constitute cause for dismissal from the service of the company.

That in consideration of the extra-hazardous nature of the business of the employer, and the interdependency existing between mine employes, the selection of workers must be confined to those who are physyically and mentally alert.

That no consideration will be given application of anyone who has the appearance of or whose past record indicates inclination to dissipation.

That, in consideration of applications, preference should be given to those of citizens of the United States or to those who have declared their intention of becoming citizens.

That no person who has not reached the legal age provided by law shall under any circumstances be taken into the organization, and indicating an age limit beyond which no person may be employed except in cases of emergency.

That certain physical defects will disqualify applicant.

That it shall be the duty of the management of the employment department to provide such forms as are necessary and to assist applicants in preparation of these forms.

Applicants are requested to fill out Application for Employment, Form 254 (*Figure 1*), stating thereon the class of work for which they are qualified, their experience in the line of work for which application is made, and giving reference to present or former employer in support of their statements. Applicants are instructed that it is necessary that they give a history of the past three years' employment, showing where and by whom employed, period of employment, occupation, pay roll number, plant name or number, name of foreman and reason for leaving the service. In the event that applicant has been in the service of more than one employer during the three-year period, he is requested to treat each period of employment as a separate item. This form carries a brief release for former employers in replying to applicant's request for reference, and shows nationality, date of birth, marital relations and citizenship of applicant. On the reverse of Form 254, provision is made for a statement of dependents at the time application is made.

Request for Reference and Release, Form 258 (*Figure 2*), is request of this department of former employers for verification of statement of applicant regarding previous service, provision being made for former employer's reply thereon. The reverse of this form carries a formal release over signature of applicant. These forms are mailed to former employer or employers, as the case may be, and upon the return thereof, applications are scored according to correctness of statements of applicants in comparison with former em-

* Supervisor of Employment and Compensation. The Union Pacific Coal Company.

Form 143 4-28-3000

To ..... Surgeon ..... Wyoming.

Introducing Mr. ..... for physical examination

The bearer has applied to this company for employment as.....

The duties of this class of employment require that workman be physically able to.....

.....

.....

Does applicant's physical condition qualify him for the above class of work?.....

Test eyes. Right eye.....Left eye.....

Note any abnormalities of eyes.....

Test, roughly, and grade hearing. Right.....Left .....

.....Rings .....(Hernia) .....

Describe any deformities.....

.....

Spine .....

Missing members .....

Varicose veins .....

Signed.....

Date of examination.....

Applicant's signature for identification Date of birth.....

Applicant's signature in presence of Surgeon

NOTE: Read instructions, on back, carefully. No.....

No.....

To..... M. D.

For physical examination of.....

Signed .....
Examiner.

Figure 3

Occupation Mine No. Date

Foreman Form H, No.

REASON FOR LEAVING

Own Accord | Conditions | Sickness | Discharged

No. of times previously employed

Length of last service

Impression as to real reason for leaving

Insubordinate
Incompetent
Agitation
Poor Attendance
Loading Rock and Foreign Matter
Details bottom line, to left

Character of Service

	Good	Fair	Poor
Work			
Conduct			
Ability			

Re-instatement

No objection
Do not re-employ
Re-employ for above Mine only
Do not re-employ for above Mine

Interviewed by

Figure 4

Form 41

.....Wyo.....192.....

To.....

Foreman Mine No.....

I have employed the bearer.....whose

signature appears below as.....*in Mine No.*.....

.....
Employe's Signature.

.....
Mine Supt.

The person whose signature appears above has been assigned Check No.....

ORIGINAL

.....
Time Keeper

Figure 5

ployer. If we are satisfied from this investigation of applicant's record that he is worthy of employment, he is notified to call at the employment department for physical examination by the company surgeon.

A record of physical examination, Form 143 (*Figure 3*), is made by the surgeon and filed in the employment office. Loss of an eye or badly impaired vision of either eye, hernia or recent or congenital weakness likely to produce hernia, varicose veins, loss of either hand or either foot or other serious physical defect will disqualify applicant.

After applicant has passed the physical examination satisfactorily, his signature is taken on Personal Record Card, Form 105 (*Figure 4*), after which the card is filled in by the employment office and forwarded to the plant or mine, where applicant has been assigned work, for identification. Later, when workman leaves the service of the company, the reverse of the Personal Record Card is filled in by mine clerk or superintendent and the completed card returned to the employment department for filing.

Advice of Employment, Form 41 (*Figure 5*), is made in triplicate, the original being workman's identification, the duplicate being forwarded by mail to the official in charge of the mine or plant, and the triplicate remaining in the employment files.

Naturally, this system of investigation of past record of applicants like other innovations, has resulted in some unfavorable criticism, one of the arguments made against the system being that carelessness in replying, or withholding reply altogether, by former employers would work a hardship on applicant, compelling him to go through a long period of unemployment pending receipt of reply to his request. This is not true, however, as our experience has been that with very few exceptions former employers are prompt and fair in their replies. In view of the fact that our companies pension old and disabled employes who have been continuously employed for 20 or more years, we feel that a man seeking employment should he in average physical condition when he enters the company's employ. The age limit fixed by the company is 50 years and this limit may be exceeded in special cases.

MATERIAL DEPARTMENT

(*From page 60*)

point at which located. This card is made up in triplicate by the material clerk, he retaining one for his files and sending one each to the purchasing agent and to the general office. Whenever equipment is transferred from one mine to another, a shipping notice giving a complete record of such equipment is sent along with the transfer, and the clerk receiving the equipment makes up a card record in triplicate in the usual manner, and these cards are substituted for those originally made up when the equipment was first purchased.

All scrap, consisting of cast iron, mixed mine wrought, copper and brass, is concentrated at one point at each of the mines and sold periodically at the highest market price prevailing at the time.

Does The COMPANY STORE Satisfy The Demands of the Employe

By E. R. JEFFERIS *

Stores must supply more than mere necessities—Travel and extensive advertising has created a demand for comforts and luxuries—Standards of merchandising must keep pace with better living standards—Views of store interiors

THE MARCH of the filling station across the country marks the progress of a civilization, that demands new comforts, new ideas, new methods. With it came good roads, chain stores, better schools and a decidedly changed viewpoint of the average consumer towards the "Company Store." This vogue for travel that intrigues the entire nation has familiarized the consumer with every inexpensive luxury that constitutes a happy and successful home life. At the same time we lost our frontiers to the filling stations, the consumer discovered the comforts, pleasure and leisure that modern heaters, electric washers, and other labor and time-saving equipment brings.

The movies have brought a knowledge of the whole world to every man, woman and child. They have furnished ideas, joy and romance, all of which have had a definite effect on our consumer and his merchandise viewpoint. Young men, within two days after a screen favorite appears in his new picture with fancy spats, ask for them at the Company Store.

The radio has done great things in a short space of time. In less than ten years a large proportion of our customers have acquired modern radio sets, which have made them acquainted with fishing barges, tooth paste, politics, naval armaments and saxophones. The acquisition of a mahogany set has brought a desire for other good furnishings, making the home more attractive and livable.

Upper photograph shows the interior of the Rock Springs store, and lower, the Reliance store

We are flooded with massive catalogues, circulars, tabloid papers and loads of other advertising literature, portraying the unusual values in anything from a ready-cut Spanish bungalow to a paper of pins. Any article, it is alleged can be laid down at your door, with tremendous savings—savings the sellers claim that will in a year's time take you on a trip to Timbuctoo or some other seaport. This is helpful rather than harmful to a well-managed store. The pretty pictures create a desire in

* Manager of Stores, The Union Pacific Coal Company.

Candy kitchen at new bakery, Rock Springs, Wyo.

Typical Union Pacific store bucher shop, Superior, Wyo.

the customers' minds for the merchandise that perhaps they have walked by in the store twice a day for two months without noticing until that colored picture turned the trick. A live local organization can capitalize this to their advantage, closing the sale at home.

Then comes the much-heralded chain store evidenced in every line of business from root beer stands to safety deposit boxes. Every weak-kneed wholesaler, banker and retailer writes articles, which our trade and other papers print, with a flourish of illustration and big type, extolling the high spots of chain organization, buying power, and sales. These writers forget to mention the merits of their own business, with the consequence they develop a complex of defense instead of staging an offensive with enough energy and enthusiasm to make the consumer feel that their own local stores have merit and deserve their patronage.

Has the company store met these new developments? Have they been able to capture the attention of their customers against this new challenge? Competition is very keen. The store executive must keep his ear to the ground for ideas to hold the consumer. The public is fickle and changeable, demanding a new idea every day. Hundreds of organizations are competing for the customer's dollar, with everything from "10 percent stock" to a package of Jello. Every week there is a drive on selling some commodity, from silhouettes to pawpaws. Large sums of money are spent in organization, advertising and "Whoopee" to put it over and it usually goes over big. Competitive stores can benefit, but unless you cooperate in organizing the opinion of your customers to special events, you will never be heard. The public does not respond without being pushed. You don't have to be a big town expert to cash in on these opportunities. Usually personality and initiative, coupled with the leads of successful merchandising organizations, make their campaigns more effective in your community.

Price is a big factor in sales. People drive all over the country burning up good gas hunting bargains. Quality hasn't the drawing power it once had—novelty is wanted now—executives and managers must recognize these facts. You can't raise a crop unless you plant, and in business you can't meet this new competition unless you have the merchandise the people want. The price, too, must be right, with a proper display to effectively draw attention. Direct advertising for company stores is the most effective. Direct advertising means hand bills, store papers and other direct mailing appeals. Support this advertising with only standard goods of excellent value.

Good management, advertising, price and quality are secondary to the sales force, which is responsible for the money in the cash register. They are the real contact between your store and the buying public. They can make or break you. They reflect the character and ability of those in charge. First teach your sales people confidence in your organization, merchandise and price. Encourage them to develop and show initiative which is the result of confident preparedness; their ideas often times develop into profitable sales to a company. Impress them with the true meaning of courtesy to customers—courtesy, not praise or flattery—as courtesy is the foundation of a company's good will with its customers and sincere interest in the needs and tastes of a customer is the backbone of service.

Honesty is inherent in over 90 percent of all humans, and if a decent, living wage is paid to employes for services rendered, this phase of the store operation is of minor importance. Complicated systems to detect dishonesty often work to the detriment of sales and profits. Figures covering gross profit and expense for the year reflect the waste caused by red tape and carelessness, including merchandise wasted by poorly kept stocks, inadequate fixtures and incompetent help; too much system adds an excessive burden to the pay roll and so does lax credit restrictions; such leaves you wide open to this new competition where low price and quality are the results of careful education to overcome just these weaknesses.

The crime of many company store operations lies in giving special discounts to executives and subordinates, assessing the man who does the actual labor an extra price for his purchases, which naturally forces him to pay more than a reasonable profit to make the store operation succeed. Worse yet is the comcompany that does this and forces its employes to trade with the store or lose their jobs. Bitterness and inefficiency result from these practices, as men imposed upon go to other fields, where modern methods and fair treatment prevail, carrying with them resentment towards all employers and all company stores. Maintain the same competitive price to all employes regardless of position. Sell on quality and price only.

Confidence in the employes of the company should be expressed in the form of installment sales of clothing, tires, radios, stoves, electric washers, etc. American standards of living now demand these simple luxuries; they add a comfort to a life that, at best, to the majority is a grim race to meet rent, living expenses and doctor bills. They likewise cover up a big bill of imaginary complaints that is ever ready to appear on the surface of any mining camp.

This new trend of the times is not a menace to the company store. We must, however, divorce our business from the old company store system and its traditions, and prepare ourselves systematically to enjoy the unusual advantages at our command. We know the company employes' likes and dislikes, their wants and desires, their ability to pay, so by proper advertising, well balanced stocks, enthusiastic sales force and a management full of energy, we can meet this new American business which will still be different tomorrow.

PLANT BUILDINGS

The Old Timers' Building at Rock Springs

Headquarters building including store and general offices, Old Timers Building, Rock Springs bath house, Bakery, Community Club Houses, Hanna Theatre—Complete descriptions of structural features and interiors

By JAMES L. LIBBY*

THE ENGINEERING DEPARTMENT of The Union Pacific Coal Company has been called upon, in the last few years, to submit estimates, design and supervise the construction for a great many different kinds of buildings, and still care for the regular engineering work. All construction work possible is handled by contract and complete working drawings and specifications prepared. The following are some of the kinds of buildings the department has handled:

THE UNION PACIFIC COAL COMPANY'S HEADQUARTERS BUILDING

The general officials, the mercantile store, the Southern Wyoming Electric Company and the Green River Water Works Company are all housed in the headquarters building at Rock Springs, Wyo. The construction is of concrete and brick with structural steel beams and supporting columns. The footings, structural members, walls and roof are designed to care for an additional story in case one is wanted in the future. Instead of the roof being finished in the usual graded manner, it is level and the same type of construction as the floors. Layers of felt and celotex are used to secure heat insulation and over this is laid a built-up 20-year roof with a gravel top.

The walls are of rough, golden buff-colored brick, laid in mortar of a similar shade. Light granite-colored cast stone trim and ornaments, stucco panels, a marquise and the window grouping with white trim on the woodwork give the exterior effect.

Due to the fact that the ceiling height required for the store is much greater than for the rest of the building, the store floor is raised about 3 ft. above the sidewalk to take up the difference in story heights. This arrangement provides for a well-lighted and ventilated store basement, with a structure two stories in elevation for the store and three for the rest of the building.

The frontage on Pilot Butte Avenue is 96 ft. and on "N" Street 125 ft., with a depth of 51 ft. and 71 ft., respectively. The intersection of these two streets is an obtuse angle of 114 degrees, making a wide angled V-shaped building.

The main entrance of the store is recessed with 35 ft. of display window on either side. These display windows have white oak floors with a walnut border, are paneled and finished in ivory enamel with color decorations. The entrance and show windows are all under an ornamental marquise.

The main store floor is 4,200 sq. ft. in area with mezzanine offices across the west end. From these offices a view is had of the entire store. Under the mezzanine is the rear entrance, stock room, elevator and the French Room with its auxiliary dressing rooms. A main stairway at the front of the store

Part of the Accounting Department, Headquarters Building, Rock Springs

* Assistant Chief Engineer, The Union Pacific Coal Company.

leads to the large basement sales department and rest rooms. The rear basement is used for storage and is provided with an electric elevator and a chute from the outside for handling merchandise, also an electric refrigeration machine.

The store floor is concrete covered with embossed linoleum of tile effect, laid on deadening felt and cemented in place. The ceilings and walls are painted in light tints, with beams, columns, pilasters, caps and borders decorated in colors. The furnishing and fixtures are in dark oak with wax finish, planned to suit all structural conditions.

The main entrance and stairway to the offices is centrally located on the "N" Street side. The lower floor has one office, a shower room, and a large stock and work room with a separate outside entrance, divided off by heavy wire partitions, for the use of the Southern Wyoming Electric Company and the Green River Water Works Company. The main floor has six private offices and a large room for clerical work. The upper floor has a spacious room for the accounting department with 2,810 sq. ft. of floor space, a large library or meeting room, five offices, an engineers drafting and a large work room equipped for blue printing, photostat and laboratory work, with an auxiliary supply room and a dark room.

The interior woodwork is oak finished in a light color, with waxed clear maple floors. The ceilings and walls are plastered with a sand finish and painted in pastel shades. All the hardware is cast bronze and cylinder office sets are used on the doors, with the main office entrance having a master lock that all office keys will fit. All the windows are weather stripped. The concrete floors throughout are treated with a slow-drying, penetrating oil that prevents dusting and polishes with use, and the oak stairways have the treads covered with heavy sheet lead which wears well and prevents slipping.

A valuable and useful feature of the building is the large vault space, built of reinforced concrete throughout, and consisting of three separate stories; the various departments are separated by concrete walls and heavy diamond mesh partitions and have access to their vault space through safe doors placed to suit their location. Each story has a floor space of 1,180 sq. ft. and is fitted with steel shelving and filing cabinets to suit the departmental needs. The space in the upper story is used by the engineering and accounting departments and the assistant treasurer; the general office, purchasing department and store have access to the intermediate portion, while the lower vault is divided into three parts where old records are filed and stored.

The different departments, the coal company's mines and stores in town and the outlying districts are greatly aided in the transaction of business by use of a private telephone exchange installed within the building, connected to the Mountain States Telephone System. This system is augmented by direct telephones on the coal company's switchboard telephone system.

The plumbing is complete and installed according to the best practice.

Interior of bath house at Rock Springs—showing shower compartment, benches and basket arrangement

Bakery, store and service station, Rock Springs

Part of Engineering Department's drafting room, with Chief Engineer's Office, Headquarters Building, Rock Springs

Vitreous china is used throughout, including lavatories in the offices. Flush valves are used in place of tanks. One of the useful things is the shower room which is accessible from the rear entrance and is fitted with showers placed in steel compartments arranged with private bathing and dressing booths. Individual steel lockers are provided for employes with extra lockers for visitors.

The system of heating is low pressure return steam with vacuum specialties, and a cast iron sectional 48-in. smokeless boiler and radiation. The boiler plant is placed in a concrete furnace room so arranged that the coal from the sloping bin will run into the feed hopper of the mechanical stoker which is of screw feed type. It is equipped with electrical operating thermostatic, pressure and time clock regulation, making it automatic in action. The boiler is equipped with an automatic water regulator, adjusted so that the water level is the same at all times. With this mechanical arrangement for the heating there is a great saving in janitor service. A 500-gallon hot water tank heating system is also located in the furnace room, using steam and a heater for heating the water. Hot water and steam are furnished from this plant for the Old Timers building, 110 ft. north.

The electrical work was handled by the Southern Wyoming Electric Company. All the work is in conduit, with neat, well-arranged fixtures, provision made for all present and future needs. The exterior is brightly illuminated at night by the display windows, marquise lighting, ornamental street lights, Southern Wyoming Electric sign and the large roof sign reading "The Union Pacific Coal Co.," which sign is 80 ft. long and has letters 4 ft. high.

View inside the bakery at Rock Springs

One end of kitchen, "Old Timers" Building, Rock Springs

Old Timers Building

The "Old Timers" building at Rock Springs, Wyo., dedicated to the older employes, is designed to care for the old timers annual meetings, large gatherings, banquets, entertainments, basket ball games, athletic sports, and can be used for auto shows and other civic activities.

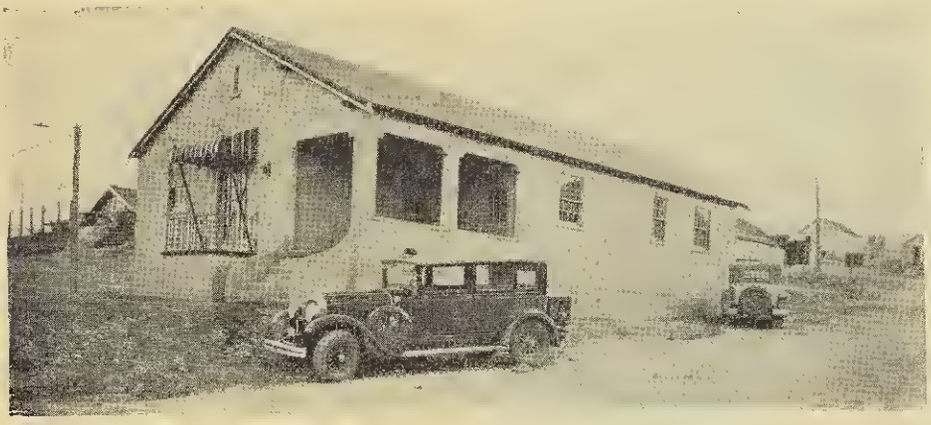
The building is a single story in elevation, with a concrete foundation, brick walls (including the inside walls of the auditorium), and steel roof trusses; has a frontage of 110 ft. and a depth of 120 ft. Ample grounds at the sides of the building and across the street are arranged for parking automobiles.

The exterior treatment consists of varying tones of red, rough-textured brick laid in black mortar; with white cast stone copings, pilaster gablets, pinnacles and ornaments; terra cotta green gray-colored square inserts, a light colored running brick course and a diaper brick panel over the entrance. All of these with the pilasters, parapet walls, gables and a broad expanse of roof covered with jade green-colored shingles with diagonal lines of contrasting shingles complete the design.

The plan consists of a recessed entrance with a ticket office at the side, a lobby with a ladies' parlor and a men's lounge with auxiliary check room on

sists of removable bleacher seats for the auditorium and stage, folding chairs, folding banquet tables and a sectional raised ring with special lighting for boxing contests. The capacity for some of the events is: basket ball 1,300, banquets 800, boxing contests 1,800, and for entertainments using the stage 1,800. All auditorium equipment, when not in use, is stored in the store room or under the stage.

The auditorium walls are finished with rough-textured brick laid with white mortar, with decorated pilaster caps. The ceiling has a heavy concave celotex cove and small square blocks of perforated celotex with four decorated ornamental ceiling grills. The perforated celotex is used to correct the acoustics by absorbing the reverberation. A border design is used on the ceiling, the stage



Community Building, at Winton, Wyo.

finished to suit the requirements of each. Ample showers are provided with steel compartments and dressing booths to care for the needs during athletic activities.

Rock Springs Bath House

The employes' bath house at Rock Springs, Wyo. (the largest one built by The Union Pacific Coal Company), is located near the lamp house for the convenience of the men in going to and from their work.

The building has a frontage of 129 ft. and a depth of 42 ft., with walls constructed of red, rough-textured brick laid in white mortar. The unplastered interior walls are finished the same as the exterior. Concrete is used for the foundation and floors; and steel sash, glazed with semi-obscure wire glass, for the windows. All the trusses and roof members are of steel construction. The roof is made up of 2-in. dressed and milled fir lumber, laid on the steel purlins, and this sheathing is covered with asphalt felt and over this a galvanized iron roof, which construction gives good insulation and little or no trouble is experienced from moisture during the colder weather.

The design necessary required caring for the needs of 500 men, but finding from experience at Reliance and Winton where a portion of the bath houses were specially constructed for the women and girls, also the boys, the desirability of this feature was established and the idea incorporated in the new building. A special bay is set apart for the use of the women and girls, and a room constructed for the boys. The women's room, with dimensions of 15 by 30, is fitted with six steel showers, each consisting of a shower stall and a dressing compartment. The boys' room is 10 by 15, with a shower compartment having three showers and the rest used for dressing. The men's change room is 35 by 112, being entered through three vestibules with two sets of double doors each. Along the entire 112-ft. length is a covered shower compartment 6 ft. wide, with four roof ventilators to carry off the vapor, containing 43 tempered and 16 hot and cold showers.

Following the most satisfactory practice, each man is provided with a basket. This basket is nearly square, made of heavy wire mesh with a double bale for hanging. A hook is provided at each of the four lower corners for hanging clothes and belongings, while the basket itself is used to hold smaller articles. These baskets are hung on a chain, passing over two overhead pulleys, allowing them to be lowered for access, but are normally raised and the free end of the chain locked to the pipe railing back of the benches.

It is necessary in a building of this sort to have a good circulation of air and heat to dry out the damp clothing, also that ample hot water is furnished. The airing is provided by means of cross ventilation from the pivoted steel sash, also the large roof ventilators all of which have damper regulation. The heating for the building as well as the water is furnished by means of steam from the boiler plant.

Live steam from the boiler house is led into a small concrete trap room under the main floor, through a 2-in. pipe, covered with 80 percent magnesia pipe covering, 2 in. in thickness and laid in 8-in. split tile. The condensation is dripped into a ¾-in. high pressure open float steam trap and forced outside into a receiver tank. After the steam is dripped it is carried through a 2-in. riser to a point overhead, this steam at about

140 pounds pressure passes through a 2-in. steam pressure regulator, and is reduced to 12 pounds (as a safe pressure for cast iron steam radiation) and is arranged to pop at 15 pounds.

From this point the mains are carried around the building overhead, and the system of heating is a low pressure return pipe system with traps on the radiators, and return mains vented by means of vacuum vapor valves. All the radiators are of the wall type, and are hung so that the bottom is 5 ft. off the floor. This keeps them out of the way and avoids more or less the danger of burning. The condensation from all the radiators, as well as the water heaters, is collected in a 100-gallon steel tank placed in the previously mentioned trap room and from here it flows into a No. 101, ¾-in. size tilt trap, from which it is forced into the same receiver that the condensation from the high pressure steam enters. This kind of a trap was selected so that in case it is desired, in the future, the trap can be calibrated and by putting a recording counter on the trip lever, the actual pounds of steam used may be determined. The condensation water thus saved is pumped for use in the power house by means of a single phase electric automatic sump pump, size No. 2 E.

The large quantity of hot water necessary for bathing is furnished by means of two 940-gallon steel storage tanks. The water in each tank is steam heated by means of two No. 4 apartment heaters. Each tank has a No. 11 tank regulator, which has a thermostatic bulb placed inside the tank, and is set to shut off the steam supply for the water heaters when the water in the tank is heated to 180 degrees in temperature. With the water in the tank at 180 degrees it is necessary to mix cold water with it to get a bathing temperature of 90 degrees.

When water is drawn from the tank it passes through a regulator and is automatically mixed with the proper amount of cold water to give tempered water for the showers. If the tank temperature is 180 degrees and the cold water 45 degrees the valve lets in double the amount of cold water that it does hot. By this means, there is available for instant use three times the capacity of the tanks, and while this is being used the heaters will heat additional water to 90 degrees at the rate of 900 gallons per hour for each tank.

A complete system of sanitary plumbing is provided. The floor in the change room is graded so that it may be washed out with a hose, with all the water running into two sumps which are designed to be easily cleaned from time to time.

The electric wires are all drawn into a complete grounded conduit system run exposed from the panel board cabinets and painted to match the walls. The lighting fixtures are of the vapor proof condulet type, complete with globe and guard. Thus constructed, the entire electrical installation is, as required for a building of this kind, moisture proof.

Bakery, Store and Service Station at Rock Springs

A complete modern bakery is operated by the store department to better care for the needs of the employes of the coal company at the different towns. The bakery, store and service station is located on the Lincoln Highway near the mines, and is especially convenient for the employes who are somewhat remote from the company's store and the business district.

Suggestive of Spanish in design, the building is of brick and tile construction with exterior flesh colored stucco finish. The combination of stucco, bright ornamental trim, artistic roofing of green and red hexagonal slate-surfaced asphalt shingles, furnish a harmonious outward attractiveness, and the spacious driveways and parking space with gas pumps so situated as to serve four cars at one time make the building adaptable to the requirements of a modern and up-to-date service station, with full equipment for tire repairing (including vulcanizing), greasing and washing cars.

The bright colored store has accessibility between the bakery and service station, with an outside entrance. Here one may purchase gasoline, auto supplies, groceries, tobacco, candies, fruit, bakery goods, light lunches and be served refreshments from a soda fountain.

The bakery occupies two large, well lighted and ventilated rooms, equipped with the latest electric machines and an electric oven. Provision is made for an additional oven to be installed in the near future. A few of the items of equipment are a high speed bread mixer, with an electrically operated sifter, for handling 200 pounds of flour at one time, a dividing and molding machine for handling the weighed bread dough, a proof box where a rack holding a complete baking of bread is rolled in to raise. Also an electric oven that holds 192 one-pound loaves of bread for baking, a combination cake machine and grinder for mixing, beating and whipping as well as grinding. An electric frying kettle for doughnuts, etc., and an electric wrapper for the bread. These are augmented by a complete line of equipment and utensils for the preparation, handling and baking in large quantities.

Community Club Houses at Winton and Superior

The need of suitable quarters for social gatherings, also realizing the benefit and success of the club house at Tono, Wash., lead to the company's constructing special buildings to fill this need, and the resulting Winton and Superior club houses for use of the Women's Clubs, Boy and Girl Scouts and other community activities.

The exteriors are Spanish in treatment, with an abundance of color. The walls are finished in a rough and irregular smooth texture cream-colored stucco, with jade-colored tile inserts. The slate surfaced shingles on the roof are green in color, with small red diamonds, and the ridge and gable rolls are of alternate red and green. The trim for the doors and windows is painted light blue in color. The construction is a frame superstructure with hydro-plastic cement on expanded metal, finished with "California Stucco." The foundations are concrete plastered with a sand finish cement mortar.

The floor plans are practically the same, but due to the topography of the ground, the surroundings, and the resulting views, the larger dimension is used for the front at Superior and the gable is placed at front for Winton. The Winton building has the club room French doors opening on a balcony with a black iron railing, and protected by a red and green colored awning supported by two spears, while at Superior the French doors open on the entrance porch. Above the Superior porch is a gable pierced by a narrow opening. This opening has a circular ornate iron railing and a lantern swinging from the soffit of the arch. The porch floors are of red colored cement, blocked off similar to tile.

The club room, furnished with decorated wicker furniture, is 23½ ft. by 39 ft., with built-in box seats, having a back and the cover hinged to accommodate the storage of equipment below, placed on either side of the fire place. The fire place is built of light granite colored glazed brick, with Clay Craft ornaments of mountain and wood scenes. The interior decorations and the stain for the woodwork were selected by the women at each place. The floors are of clear maple waxed and covered with rugs. Side lights of the candle type with polychrome fixtures are used for lighting the club room and the entrance hall. A ceiling fixture of the same pattern is also placed in the club room.

The kitchens, all painted in enamel and the floors covered with bright colored inlaid linoleum, are 12 by 22½ ft., furnished with an enameled iron range, built-in cupboards, broom closet and ironing board. An enameled iron sink on legs with a double drainboard is placed under the window and a long drainboard with cupboards under is provided for handling the dishes. A heavy serving or work table and open shelving near the range complete the kitchen equipment.

Hanna Theater

Spanish design, having cream colored walls of stippled texture; with coping, window and door ornaments of white stucco, narrow recesses of green, a bright colored awning and a window balcony with a black iron railing, characterize the exterior of the theater building at Hanna, Wyo.

The building has a two-story elevation in front, covers an area 72 by 120 ft. It contains a theater, dance hall, pool room, refreshment parlor, barber shop, rest and cloak rooms on the first floor, and the second floor has a lodge room, 22 by 35½ ft., with ante and six property rooms in connection for different lodges and societies, also a kitchenette.

The theater has a seating capacity of 346 and the leather upholstered opera chairs are placed on a bowled floor, it is complete in its appointments to handle road shows and silent and photophone pictures. The stage has a proscenium, 22 ft. wide, a scene loft with a grid and several dressing rooms. The projection room, located over the ticket office, is entirely fireproof, equipped with a photophone, type F, with both sound on the film and disc equipment, Motiograph De Luxe Model projectors, an Actodector motor generator furnishing the d. c. current.

The system of heating is low pressure steam with vacuum specialties. Unit type heaters with electric blower fans are used to heat the theater and dance hall and the other rooms have direct "Corto" radiation. The cast iron sectional, smokeless boiler is placed in a concrete furnace room with a separate outside entrance.

Ventilation is provided for the theater by means of a blower fan with an air diffuser, taking fresh air from the outside and a ceiling grill with a damper regulated ventilator for the exhaust. The dance hall and lodge room have exhaust fans for ventilation.

Complete electrical devices and equipment are provided for the stage lighting, including dimmers for both stage and house lights, remote control for the curtain, and loud speakers placed near the screen, as well as the previously mentioned equipment in the projection room. All electrical work is in conduit on separate circuits, having enclosed safety switches, located in the furnace room. Neat lighting fixtures, conforming to the interior color scheme, are used.

The construction is a concrete foundation, with a concrete floor for the theater, a heavy frame superstructure, with built-up wood trusses, metal lath and plaster inside, and sheathing, asphalt felt and stucco on expanded metal for the exterior. The flat roofs are covered with a 20-year gravel top built-up roofing.

COMMUNITY ORGANIZATIONS

(*From page 65*)

then dining together in a Scout fellowship of fun! As a prize the boy winners of this contest were sent for a week's motor trip through Yellowstone National Park and the girl winners attended the international first aid meet at Kansas City, giving two demonstrations for the 50 teams contesting there. At the annual Girl Scout Mothers' and Daughters' banquet we have had such speakers as the Governor of our state and the dean of women of our state university, adding width to their horizon and the realness of personality to their desire to cherish the beautiful and strong in life.

Camping is always a part of scouting for boys and girls and a series of three two-week camping periods are conducted in the mountains north of Rock Springs despite the 145 miles of motor travel necessary to transport food and campers. The grandeurs of Wyoming mountains are at the end of the journey. Parents and friends drive the Scouts and the huge trucks of The Union Pacific Coal Company are used to transport food and supplies.

Women's Clubs

Women's clubs have been organized and are affiliated with the National Federation of Women's Clubs. This last because, despite a lack of usable or applicable program material in the Federation, a club having a direct contact acquires a secondary social personality from its consciousness of national unity.

Two splendid new club houses for the girls and women have been built in Winton and Superior. Representatives of the women's organizations and the Girl Scout captain were asked to help plan these buildings which are modern in every way, have an up-to-date kitchen, a cozy living-room with a fire place. These club houses and club rooms in other towns make it possible to accommodate such classes as are available through the adult education and vocational extension classes of the State Department of Education, as the women's clubs are the medium through which this service and others available are claimed for the women of our towns. Classes in food selection, home management, sewing and child care have been conducted.

Employes' Magazine

Our *Employes' Magazine* has now completed its fifth year and there is abundant evidence of its popularity with an increased feeling that it belongs to everyone, is a publication in which each employe, his wife or child may, with right, ask for inclusions. It is no longer the *Employes' Magazine*, but *The Magazine*—ours. Departments include: Editorial, written by President Eugene McAuliffe; Safety, by Safety Engineer J. A. Smith; Engineering, by various members of the engineering staff; Old Timers, in which is carried stories about the older employes and their families as well as stories told by them; Humor, of Interest to Women, Girls, which is the medium for the exchange of Girl Scout news and program material; Our Little Folks; News—and, each month some feature story, art study of seasonal or popular interest; or article of cultural value, with drawings and sketches by employe artists. Although only 120 employes contributed in a year material it was possible to sign, many more asked that happenings and folks be written and were glad to help find things of interest. Certainly its pages can be the medium for the stimulation of every worth-while and building factor in our group living.

Old Timers' Association

The Union Pacific Coal Company Old Timers' Association was organized five years ago for the purpose of "banding together in good fellowship all senior employes, thereby renewing and thereafter maintaining, the association and friendships of earlier days, an annual get-together meeting to be provided for this purpose." Men whose term of service with the company or related companies equals 20 or more years are eligible to membership. There are 435 members, many of whom have seen 35 years of service, not a few 40 years and one hale old gentleman 55 years of service. Because it includes in its membership those who worked for "related companies" there are men who helped build the Union Pacific Railroad and know the romance and struggle of the early days of the new West of America. Among these are still a few old Chinamen, the most of whom have during the last few years been sent home to China.

The annual celebration of the Old Timers' Association is an event of all southwestern Wyoming, and old timers, long out of service, come from the near-by cities of Utah and Colorado, as well as from other parts of our own state. Speakers of high standing and unusual appeal have been brought to Rock Springs for the celebration and the younger folks of the community delight in the opportunity to honor the old timers. One year it was a privilege to stage a pageant giving a pictorial presentation of the history and happenings of the company's coal districts since coal was first found, using 350 participants, many of whom were old timers themselves; the libretto written from the tales of old timers. (*Continued on next page*)

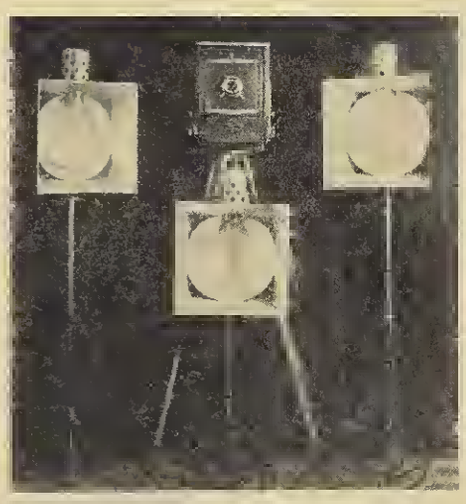
UNDERGROUND PHOTOGRAPHY

By V. H. WILLIAMS *

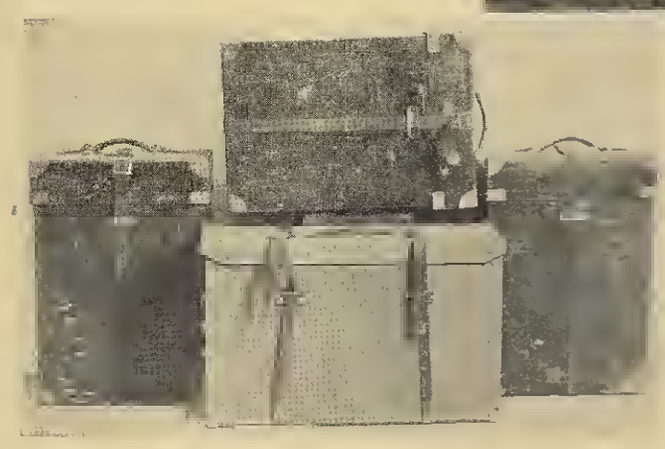
Brief description of equipment used, the problems encountered and methods employed in overcoming the difficulties of underground photography at The Union Pacific mines

FEW people know or realize the amount of time and labor spent in taking underground pictures. Frequently, to produce one picture, it requires several hours' work to make a single set-up. Our equipment for the most part is very fragile and delicate and we find it advisable to carry this equipment about the mine rather than to transport it in cars. For that reason, we use the three Ventlite Kompact outfits and camera shown in the pictures.

In order to make a picture of any subject we must have sufficient light; the Ventlite system or equipment has proven itself very efficient and durable. The photo-blue, actinic ray, 1,500-Watt, 230-volt globes are set in aluminum reflectors which are equipped with a socket and a switch and are specially built for photographic work. The stands supporting the reflectors are a folding type, easily adjusted to the required height. The camera used and shown is a 6½ x 8½ Eastman View, with an extremely wide angle lens which is very advantageous in taking close-ups in narrow places such as entries and crosscuts.



Above—Lights and camera set up to shoot a picture.



Left—Cases for carrying the photographic equipment in the mines.

In taking pictures underground one encounters adverse conditions, for example, the air is usually full of dust particles which tend to obstruct and hold back the light, the subjects are black and the coal gives a black background, all of these have a tendency to absorb the light. In other places one finds props so closely spaced that it is nearly impossible to place the lights about the camera so that all or most of the shadows may be cut out. Distortion is the most persistent obstacle of all to overcome, for, with a few exceptions, some object is much too close to the lens. The problem of changing position in an already cramped condition is not an easy one. There are many other things that might be mentioned, but, everything considered, photography underground is very closely related to work in the studio.

* Construction Engineer, The Union Pacific Coal Company.

COMMUNITY ORGANIZATIONS
(From preceding page)

SUNDAY SCHOOLS

Thirteen Sunday Schools are conducted in the towns, some of them denominational, and many of them being Union Sunday Schools. Here, the finding and encouragement of leadership is the most complete service that can be rendered.

It follows, of course, that the organization back of the activities here outlined can not be set up once for all. Even in our rather stable mining towns changes in personnel are constantly taking place and new leadership is constantly being found. And, again, organization is deliberately changed. What we need to ask ourselves is whether or not we see the social tasks of our communities (social tasks are not peculiar to mining towns but belong to every community), with the significance of a company-owned town, its health and recreational problems; whether we are entirely willing to "go along with" the community endeavor initiated by others even when we see other ways; whether we constantly remember that while the student of social science must take training as long as that of physicians, it's practice must help others to work out their problems to their own development and advance.